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**Newspaper coverage of genetic modification events in China, Thailand and
the United States: A cross-cultural analysis**

by

Zheng Xiang

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Journalism and Mass Communication

Program of Study Committee:
Lulu Rodriguez, Major Professor
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Ames, Iowa

2007

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ABSTRACT

This study compares how the English-language newspapers in countries—China, Thailand and the US—covered two genetic modification cases. In China and the US, the topic analyzed was the genetic engineering of rice. In Thailand and the US, it was the genetic alteration of papaya.

Using the social amplification of risk framework, the hoopla effect, and framing, the intensity, the pattern and tone of this coverage, the sources cited, and the frames employed were determined. This was done through a content analysis of news articles.

The results showed that across nations, the scientific and economic frames were the most frequently used, except in Thailand where the political frame was the second most dominant. The findings suggest that the relationship between a nation's level of press freedom and the use of frames is not linear. A country's policy toward biotechnology and frame use may also have a curvilinear relationship.

CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

Since the early days of civilization, human beings have made efforts to select and modify plants to develop specific characteristics. At times, the objective of such efforts is to come up with better tasting crops high in nutritional content. In other instances, scientists aim to make crops resistant to insects and diseases. These days, traditional plant breeding practices have been partly replaced by genetic modification (GM) that has allowed scientists to “cut and paste” genetic material from one type of organism to another toward the goal of improving crop production and crop quality. This breakthrough, however, has been greeted with mixed reactions by nations the world over. In many places, it has generated intense debates in the political, economic and cultural areas because genetically modified crops are different from any other biotechnological application in terms of their perceived effect on food safety and human health, on the environment, and their potential for economic growth.

According to Kasperson et al. (2001), risks perceived as accompanying a technological or scientific breakthrough, whether real or imagined, are amplified or attenuated through a hazard chain. An initial event along this chain emits a “signal” that a threat has occurred or is imminent. Extensive media coverage interprets the meaning and projects risk signals, imputing blame, trustworthiness of actors and agencies involved and public vulnerability, among others. Because most of society learns about risks and risk events through information channels rather than through direct personal experience, the mass media are major agents or major “social stations” of risk amplification. Particularly important in

shaping group and individual views of risk are the extent of media coverage, the information conveyed, the framing of the risks and the innovation, the presence of risk signals in media coverage, and the symbols, metaphors, and discourse used in depicting and characterizing the innovation and the risks it may carry.

Information about the innovation and the risks it may engender flows through multiple communication networks—the mass media, the more specialized media of particular professions and interests, and the more informal personal networks of friends, family and neighbors. Of these, the most commonly studied are the mass media and their multiple roles as entertainers, watchdogs, gatekeepers and agenda-setters. Many argue that they cover science and technology selectively, providing a disproportionate amount of space and airtime to breakthroughs that are rare and dramatic while downplaying more “commonplace” scientific findings.

Social institutions and organizations also take on prominent roles in society’s handling of scientific issues with risk ramifications. Large organizations—multinational corporations, business associations, consumer and advocacy groups, government agencies—largely set the context and terms of society’s debate about the benefits and disadvantages from scientific breakthroughs and other discoveries. Risk issues are also important items in the agenda of various social and political groups such as non-governmental organizations with environmental or health concerns. The nature of these groups figures in the definition of risk problems, the type of rationality that underlines interpretation, and the selection of regulatory and management strategies.

How the mass media and these social institutions function to amplify or reduce risk signals has been the subject of considerable research attention in recent years. The current study focuses on a specific mass communication medium—newspapers—as an “amplification station” of risk attendant to genetic crop modification. It deals with two specific instances of genetic engineering that ostensibly carried risk “signals.” The “risk event” common to these two cases involved the release of a scientific finding in peer-reviewed scientific journals of the discipline, a report from advocacy groups or the release of a government report that provided new information about the discovery and the risks it may or may not entail. The issues, that of the public acceptance of GM rice or GM papaya in the three countries, also share a common trait—they have received some media attention and underwent what can be considered a limited “life span.” That is, the amount of media coverage they generated in these three countries experienced a take-off point specifically at the time of the journal article, a report from advocacy groups or government report release, and then subsided after a specific period of time.

These circumstances allowed for the examination of how the views of different social actors and agencies characterized and interpreted the benefits and the risks they perceived in GM rice or GM papaya. They also accorded the opportunity to explore mass media performance in heightening or alleviating risk factors inherent in the highly debated topic of genetic modification involving crops considered to be of high economic significance in each of the three countries to which they have been applied. That each of the crops involved have uses that are of economic value to the countries involved may also have a bearing on how the issue played out in the countries’ respective media systems. More importantly, these circumstances offer a unique opportunity for a cross-cultural comparison of media coverage.

Such comparisons are particularly important for advancing risk communicators' understanding of the impact of different journalistic regimes, media systems and political policies on media coverage of biotechnology.

The two risk events to be examined in this study are as follows:

Per hectare pesticide use in China has tripled over the past 20 years, causing severe health problems among humans—including chronic liver and kidney disease among farmers—as well as water pollution and damage to non-target species (Zhang, 2000). Bt rice, scientists argue, could give farmers a fresh start in their battle against pests. Scientists in the Chinese Academy of Sciences claim that this genetically altered rice is the answer to some of the rice farmers' major problems, such as environmental pollution and the high cost of production inputs. Some news stories in China, however, have alluded that the GM variety is being “pushed down the throats of farmers” by scientists who are motivated more by their own economic interests than by a genuine desire to improve the condition of Chinese farmers. In the US, the issue also received some media attention. In that country, the innovation was first lauded as a solution to world hunger and malnutrition. But when the US Department of Agriculture announced in 2006 that US commercial long-grain rice supplies have been contaminated with “trace amounts” of genetically engineered rice unapproved for human consumption, sectors opposed to genetic modification *per se* gained new headway in decrying the potential negative health effects of biotechnology and the “perils of pro-biotech policy-making.”

In Thailand, scientists who have genetically altered papaya so that it can withstand the widespread and destructive ringspot virus have come under fire. Greenpeace, an international environmental group opposed to GMOs in general, has accused agriculture

officials of selling GM papaya seeds to farmers in the northeastern province of Khon Kaen. Government research stations, however, insisted that some of these seeds have leaked out of test plots only by accident. Subsequently, the Thai government ordered strict controls over field-testing to prevent further seed scatter. As Thai news reports question the government's GM regulatory and management practices, field verification trials have stalled.

The genetic modification of papaya originated in the US as a response against the destructive ring spot virus that has threatened Hawaii's papaya industry. Commercially released in 1998, genetically altered papaya was initially credited with saving one of the state's most lucrative export products. But because its most avid importers included the European Union and Japan who are averse to anything genetically altered, the state suffered a setback. Moreover, Hawaii's organic farmers were worried their plantations may be cross-pollinated by seeds from nearby commercial GM papaya farms. By September 2004, some farmers were claiming that a study they financed showed major contamination of their trees by genetically engineered plants, a development that cut deeply into their Japanese export market.

The case of GM rice has significantly affected both China and the US. GM papaya also had repercussions for both the US and Thailand. These two issues, therefore, offer an opportunity to examine how these genetic modification events were portrayed in these two pairs of countries affected by the genetic alteration of crops economically important to them. How prominently were these issues covered in each country and what was the pattern of coverage? Was the coverage more favorable and supportive, or more unfavorable and critical of GMOs? What sources have journalists used to explain these issues to their respective

audiences? What was the most common news frames used in the print media coverage of transgenic crops?

Understanding the answers to these questions is of importance not only for communicators, but also for the biotechnology industry, government regulators, scientists, and advocacy groups. In a very real sense, the tremendous mass media coverage of transgenic research and its products has made this a social issue as opposed to a purely scientific one. That is, future research funding, regulation, and public acceptance of this practice is now to some extent out of the hands of scientists, and into the hands of those who can influence mass media coverage and subsequent policy and funding initiatives.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Why are some scientific issues heavily covered while others are not? Why are some subjected to critical coverage while others seemingly receive an outright stamp of approval? Current literature offers three partial answers to these persistent questions.

The first explanation comes from the social amplification of risk framework (SARF) which posits, among others, that the prominence of media coverage of risk topics is partly determined by groups in society that are potentially able to generate activity that can lead to public awareness and response (Kasperson et al., 2001). Kitzinge (1997) asserts that the motivation, organization and resources of social groups are crucial for the rise and fall of risk reporting specific to a given issue. Individual or community response to the perceived risk may result in serious social influence, such as declines in residential property values, distrust of risk management institutions and even social conflict.

Second, dramatic “triggering events” may jump-start increases in media coverage and public attention to scientific issues which Abbott and Eichmeier (1998) call the “hoopla effect.” The findings of their content analysis of newspapers in the US and abroad indicate that coverage of a particular topic goes through three distinct phases. In the first, the pre-hoopla period, information and predictions about an innovation are usually overly optimistic. Over time, the tone of reports becomes less positive as sources begin to include opposition or competing groups. Peak coverage signals the second phase, the hoopla period. The hype often seen at this phase is mainly due to two factors: the self-interest of promoters

and the tendency of the media to look for new information and to present over-optimistic claims about the innovation. The issue then loses steam and attention in terms of frequency of occurrence during the third stage, the post-hoopla phase.

Hu (2002) found a similar trend when he studied the early stages of the diffusion of e-commerce. He observed that early information and predictions about e-commerce were overly optimistic, produced mainly by research firms rather than by investors and businesses. These early reports focused primarily on the main effects of the innovation rather than on indirect social impacts. Over time, the tone of coverage tended to be significantly less positive as reports began to include more social ramifications.

Abbott and Lucht (2001) also found that the media react to certain events associated with risk topics which they called “triggering events.” These triggering events exert an important influence on framing by calling attention to certain aspects of a scientific risk topic. But due to their natural tendency to report both sides of an issue, journalists provide opposing points of view that introduce controversy into the coverage dynamics. Thus, triggering events not only increase coverage of a scientific issue; they also prompt journalists to shift from a “benign science” model to a “controversial” model of covering scientific risk events. Kitzinge (1997) agrees, noting that the decline of British media reports on human genetic research was partly due to the lack of events to serve as news “hooks.”

In this study, a single critical triggering event ignited media attention to GM issues in three countries—the release of information regarding the innovation in scientific journals or the widespread publication of reports from government and non-government sources about the innovation.

In China, a report titled “Research and commercialization of GM crops” advocated for the commercialization of GM rice by scientists in the Chinese Academy of Sciences, and generated substantial media attention in 2004. In Thailand, Greenpeace’s official report published in national newspapers that agriculture officials are selling GM papaya seeds to farmers grabbed the media limelight in 2003. In the US, in 2006, the Department of Agriculture announced that American commercial long-grain rice supplies have been contaminated with genetically engineered rice unapproved for human consumption. In 2004, a study financed by organic farmers demonstrated that their papaya plantations may have been tainted by GM seeds from nearby commercial farms, causing them to lose their certification. These initial triggering events and the subsequent actions they generated garnered and sustained the media’s attention over a period of time.

A third factor that leads to the rise and fall of media coverage of issues with scientific and technological underpinnings is public reaction to these events resulting from how issues were framed by the different social actors that contest the virtue or disadvantages of these discoveries. These frames, espoused by different stakeholders, are evident in mass media reports about these issues.

2.1 Framing Theory

Researchers (i.e., Kasperson et al., 1992) have long underscored the need for substantial further research to define the relationship between mass media coverage and the formation of public opinion concerning risks. Subsequent studies along these lines have shown how complicated these relations are. Renn (1991), for example, posits that the volume and intensity of coverage is only one of the many influences of the media on public perceptions of risk. Filtering effects, deleting and adding information, changing the order of

message presentation, changing the context, and what he calls “multi-channel effects” can also be important. Others (i.e., Wilkins, 1987; Wilkins and Patterson, 1991) see the media, whether providing warning or reassuring messages, as extensively framing discourse and perceptions in which the social processing of risk occurs. Indeed, as Vaughan and Seifert (1992) persuasively argued, the media play an important role in how risk problems are framed and socially constructed. This study employs framing theory to analyze media coverage of genetic crop modification in an international context.

Goffman (1974) defined frames as “embodiments of the principles of organization that govern social events” (p. 7). Based on this definition, all forms of human experience and their documentation are subject to framing. Goffman’s work focused on describing the basic frameworks of understanding available in a society to make sense of events. He explains that from the various ways of interpreting any given reality, the specific interpretation used depends on the framing of that reality. Berger and Luckmann (1967) made a major contribution to the development of framing as a theoretical proposition by pointing out the ways by which groups sort their collective experiences of reality into categories and how they evoke those categories into processes that give meaning to new information and experience.

Studies have shown that to many, the media are the most important sources of information about scientific innovations and risks. From newspapers to the Internet, the media play a major role in influencing public risk perceptions by, among others, connecting officials to citizens, serving as channels of information between groups of professional stakeholders, acting as national and international conduits for news reports and analysis, and offering a venue for public and political debate on the handling of potentially risky

events (Feldman, Drache and Clifton, 2003). It is highly probable, therefore, that the public's understanding of scientific and risk issues—topics that are distant from their personal experience—is shaped by how the media frame such stories or how they present the news.

Recent work on the concept of framing by Entman (1993) has focused on refining the definition of a news frame. According to him: “Frames define problems—determine what a causal agent is doing with what costs and benefits, usually measured in terms of common cultural values; diagnose causes— identify the forces creating the problem; make moral judgments—evaluate causal agents and their effects; and suggest remedies—offer and justify treatments for the problems and predict their likely effects” (p. 52).

Synthesizing what many have observed as fractured and disparate applications of framing in communication research, Scheufele (1999) submits that when media frames are explored as dependent variables, this approach involves looking at the factors that may potentially influence how journalists frame a given issue. This study puts forward the notion that several factors influence the creation of news frames specific to the two GM issues.

Based on previous research, at least five factors have been identified as affecting how journalists frame a given issue: (1) their social norms and values, (2) their organizational pressures and constraints, (3) the pressures exerted by interest groups, (4) journalistic routines, and (5) the ideological or political orientations of journalists (Scheufele, 1999). In addition to these five previously identified antecedent factors, this study posits that (1) the level of press freedom a country's mass media system enjoys and (2) the policy orientation each country has adopted toward biotechnology will also have an impact on media frames (Figure 1). These two variables fall within what media sociologists call the socio-cultural

domain within which a particular media system operates. A discussion of these potential determinants of media frames within the context of the three nations is therefore in order.

2.2 Media Systems and Press Freedom

The US has a long tradition of legal protection for press freedom. Press freedom is protected by the US constitution and state law and has consistently been reinforced by decisions of the Supreme Court. Under US law, radio and television airwaves are considered public property and are leased to private stations, which determine content. The Federal Communications Commission (FCC) is charged with administering licenses and reviewing content to ensure that it complies with federal limits on indecent or offensive materials, among others (Freedom House, 2005). An ongoing concern about the US media system is the increasing concentration of ownership in the hands of a few. This concern has intensified in recent years following the purchase of media entities, especially television networks, by large corporations with their own economic interests but with no previous journalism experience (Freedom House, 2005).

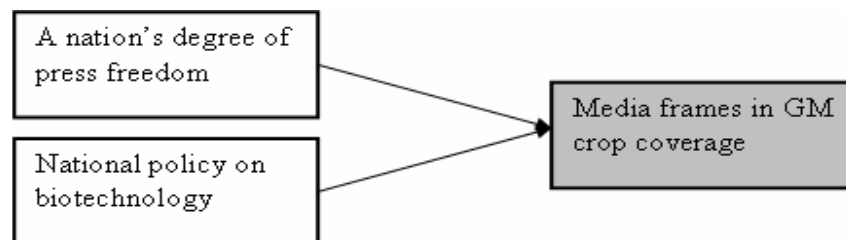


Figure 1. Hypothesized predictors of media frames in the coverage of GM crop

In the US, media researchers generally agree that media attention on genetic technology was largely non-existent in the 1980s and early 1990s. According to Vilceanu (2004), media coverage of genetic modification rose after 1998 due to significant campaigns launched by multinational corporations, non-governmental organizations, consumer groups and government entities. The robust debate on the topic included

economic issues, such as the enormous budgets invested in the production of genetically modified crops; political issues, such as laws regulating the safety of genetically modified crops; and social issues, such as the ethics and morals involved in the genetic modification of crops.

In China, the news media are tightly controlled by the Central Propaganda Department of the Chinese Communist Party. Although the government keeps a close watch on what it considers to be sensitive topics, there is comparatively free space for non-political issues as media reforms have allowed the commercialization of media operations to some degree. All Chinese media are owned by the state, but the majority no longer receives state subsidies and now relies on income from advertisements. Some scholars argue that the commercialization of media operations has acted as a freedom-inducing pressure, shifting the media's loyalty from the Party to the consumers (Freedom House, 2005).

It is difficult to determine the extent of Chinese consumers' knowledge about GM foods and what their attitudes are about GM crops as a consequence of mass media exposure. Results from a national survey conducted by Xuan and Zhou (2002) indicated that only 5% of Chinese consumers think they know the issues concerning GM foods well; 63% said they know "a little," and the rest (32%) reported they know "close to nothing." Analyzing two official newspapers and two popular newspapers, Zhong (2002) observes that genetically modified foods have attracted media attention since the late 1990s. This comes in the heels of new developments in transgenic technology, especially the commercialization of some GM crops, and the increasing debate on food safety issues throughout the world. He notes, however, that popular papers had been more negatively disposed toward GM food safety than

the official government newspapers. His respondents, in general, consider the government papers more reliable in providing information concerning this topic.

In Thailand, strong constitutional protections for freedom of expression are balanced by laws that enable the government to restrict this right in order to preserve national security, maintain public order, or prevent insults to the royal family or to Buddhism. Conflicts of interest remain a concern as corporations controlled by those in the highest public offices or with ties to the ruling party own or have shares in a growing number of private media outlets. These corporations also exert influence over editorial policy. The government rewards media outlets supportive of its policies through the allocation of advertising by telecommunications firms and state enterprises (Freedom House, 2005). Thai newspapers, according to McCargo (2001), often function as mouthpieces of political parties or important figures rather than as businesses. There is a lack of investigative reports, and serious conflicts of interests undermine the credibility of the news media.

Freedom House's global press freedom rankings rate the US, 17; Thailand, 42; and China, 82 on a scale of 1 to 97 where a larger number indicates less press freedom. It describes the US as "free," the Chinese press as "not free" and Thailand's as "partly free."

2.3 National Biotechnology Policy

In China, Thailand and the US, biotechnology has challenged policy-makers' risk management capabilities. Policy choices toward GM crops may be classified according to who controls the technology and according to how government decisions are made (Isaac, 2002). This study, however, subscribes to Paarlberg's (2001) typology that proposes a scale of four possible national postures toward GM crops. In this scheme, policies designed to accelerate the spread of GM crop and food technologies within the borders of a nation are

characterized as “promotional.” Policies that attempt to be neutral toward the new technology, intending neither to speed nor to slow its spread within a nation’s borders, are described as “permissive.” Policies intended to slow the spread of GM crops and foods for various reasons but without banning the technology altogether are labeled “precautionary.” Finally, those that aim to block or ban the spread of this new technology entirely within national boundaries are called “preventive” policy postures. In Paarlberg’s categorization system (2001), governments can choose to be promotional, permissive, precautionary or preventive in the following five policy areas: intellectual property rights, biosafety, trade, food safety and consumer choice, and public research investment policy. A nation’s typical stance on these four areas within each policy posture is described in Table 1.

The US is the foremost example of a country that adopts a highly promotional policy. It has been the world leader in the cultivation of GM crops for years and currently accounts for the majority (59%) of the total world acreage of GM crops (International Service for the Acquisition of Agric-Biotech Application, 2004). In the US, GM crops have “substantial equivalence” with non-modified crops. GM labeling is voluntary, with government agencies claiming there is no evidence of negative impact on health and the environment.

During the 1990s, agricultural biotechnology offered an increasing number of American products to an increasing number of countries, which led to trade conflicts between the US and the European Union. The US-based multinational corporations that export genetically modified seeds and food products were “pitted against those countries that wish to impose stricter control on GM imports for reasons of food safety and environmental concerns” (Falkner, 2000, p. 142).

Table 1. Description of four potential national policy postures regarding GM crops (Adapted from Paarlberg, R. (2001))

Policy Areas	National policy posture			
	Promotional	Permissive	Precautionary	Preventive
Intellectual Property Rights (IPRs)	Full patent protection; strong patent protection to plant breeders	Prior authorization is required for, for example, the use of harvested materials from protected varieties	Protects traditional farmers' privilege to use and exchange (but not sell) seeds of protected plant varieties for propagation	No IPRs for plants or animals; IPRs provided on paper that are not enforced
Biosafety	Only token screening or approval based on approvals in other countries	Case-by-case screening for demonstrated risk based on intended use of product	Case-by-case screening for scientific uncertainties as well as demonstrated risks owing to the novelty of the GM process	No careful case-by-case screening; biosafety risk assumed because of GM process
Trade	Encourage import of GM seeds or plant materials through little or no regulation; use World Trade Organization (WTO) to insist upon market access for GM crop exports	Regulate GM seeds and plant materials but in accordance with WTO regulations and no more tightly than non-GM crops	Regulate imports of GM seeds and materials separately from and more tightly than non-GM crops; impose labeling requirements on imports of GM foods or commodities	Block all GM imports so as to remain GM-free either for non-trade purposes or in hopes of exporting GM-free crops to capture export premiums
Food safety and consumer choice	Draw no regulatory distinction between GM and non-GM foods either when testing or when labeling for food safety	Use a separate but comparable safety standard when screening GM foods; require labels for GM products, but based only on detectable GM content	Use a separate and higher standard when screening GM foods and require comprehensive labeling of all GM foods enforced through segregated market channels	Ban sales of GM foods or require warning labels that stigmatize GM foods as unsafe for consumers

Table 1. (continued)

Public research investment	Spend treasury as well as donor resources on crop transformation capacity	Spend treasury resources to breed into local varieties the desirable traits of GM crops already transformed elsewhere	Spend no significant treasury resources on local breeding or transformation of GM crops; allow donor funding of GM trait transfers through conventional breeding	Spend neither treasury nor donor funds on the development of any GM crop technology
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Chinese policymakers consider agricultural biotechnology as a strategically significant tool for improving national food security, raising agricultural productivity and creating a competitive position in international agricultural markets. Consistent with these aims, China has developed agricultural biotechnology since the mid-1980s. By 2001, China has become the fourth largest grower of GM crops after the US, Argentina, and Canada (Ma & Wang, 2002). Huang and Wang (2002) suggest there are many competing factors that exert pressure on Chinese policymakers to continue with research and commercialization of transgenic crops: the demand of producers and consumers, the current size and rate of increase of research investment, and past success in developing these technologies.

China has fashioned a set of policies toward GM crops that have, for the most part, allowed the technology to move forward. In general, Chinese policies toward GM crops indicate that in key areas such as biosafety and trade, the country has been more permissive. China is the first nation in the world to grow GM crops, having planted GM tobacco over a significant area late in the 1980s. In the 1990s, China then developed its own Bt cotton varieties and approved them for planting on a commercial scale along with an imported Monsanto variety. The country also approved the commercial use of GM tomato and green

pepper varieties it had developed, and pushed ahead with field tests of its own GM rice (Zhang, 2000). China's original promotional stance went permissive because while the Chinese leadership welcomes what GM crops can provide, it does not wish to enlist in promoting GM crops to others (Chen, 2000). Although it wants to develop GM technologies it can be proud of, it also wants GM crop policies that will not invite too much international scrutiny or criticism (Paarlberg, 2001).

Thailand's GM policies have zigzagged over the years. After embarking on government-backed experimentation in the 1990s, Bangkok clamped down on GMOs in 2001 in line with the European Union's *de facto* moratorium on bioengineered crops. The EU is one of Thailand's largest food-export markets (Crispin, 2004). On August 20, 2005, then Prime Minister Thaksin Shinawatra, who also chaired Thailand's National Biotechnology Committee, announced that he will overturn the country's ban on commercial production and trade in GMOs, declaring that his government "will not allow the country to miss the biotechnology train." He endorsed the National Biotechnology Policy Framework that is highly favorable toward biotechnology in order to accomplish the goal of promoting Thailand as "the kitchen of the world" and to encourage the "emergence and development of new bio-businesses" (Thai Government, 2005). The Thai cabinet stalled deliberations on this proposal, however, and opposition began to mount. On September 19, 2006, a military junta overthrew Thaksin's government amidst allegations of corruption, and warned him against returning to Thailand. It is not clear whether the ruling junta will subscribe to his pro-biotechnology policies, but there are no indications that the country has moved away from its generally permissive policy toward GM crops.

2.4 Research Questions and Hypotheses

Considering the foregoing literature review, it is pertinent to ask the research questions and pose the hypotheses outlined below.

Following the tenets of the hoopla effect, which proposes that issues undergo a cycle of peaks and valleys in coverage as dictated by the occurrence of triggering events:

RQ 1: How intensely did the three countries' newspapers cover the two genetic modification incidents?

RQ 2: What was the within-country pattern of this coverage? Is there any difference among the countries in terms of pattern of coverage?

The social amplification of risk framework proposes that the media landscape becomes a very formidable battleground where some different stakeholders compete for public attention and acceptance of their positions on scientific and risk issues. Therefore, this study asks:

RQ3: What is the orientation of the coverage of the GM event in each country?

Because the Chinese media are tightly controlled by the Central Propaganda Department of the Chinese Communist Party and because the government solely determines policy regarding genetic modification, government sources are predicted to be cited the most in the Chinese newspapers' coverage of GM rice. In Thailand, considering the government's active role in supporting bio-businesses and biotechnology research, government sources will be cited most frequently. Previous studies about the coverage of scientific issues in the US have argued that sources of information were often not consistently used, were surprisingly limited and that government and industry spokespersons were more often referenced than other sources. It is thus expected that government and industry sources will be mentioned the

most or will get the greatest number of attributions in the newspapers' coverage of GM rice and GM papaya. Thus,

H1: Government sources will be cited the most in the three countries' media coverage of these GM incidents. In the US, the most cited sources will also include those from industry.

Even though the Chinese press is under strict government control, observers say it enjoys greater freedom when it handles relatively non-political issues. As such, it is predicted that the press discourse on GM rice in China will focus more on economic and non-political frames. Because the government plays an active role in promoting GM crops and in bolstering GM research, the political frame is expected to be employed the most in Thailand. The US has been the world's leader in the cultivation of GM crops for years. Because it has a high economic stake on the success of GM crops throughout the globe, the economic frame will be most obvious in the US coverage. Hence,

H2: In the Chinese and American press, the economic frame will be used the most. In the Thai papers, the political frame will be the most dominant.

Finally, this study examines media frames as a dependent variable affected by various factors that influence how journalists portray a given issue (Scheufele, 1999). From Scheufele's conceptualization, this study regarded media frames as the dependent variable, influenced by a country's state of press freedom or the degree to which the press is free from government-imposed and other constraints in reporting the news. Aside from this important factor, this study adds another potential determinant of media frames, a nation's espoused policy on biotechnology. Thus, it is hypothesized that

H3: The framing of GM events will be a function of the degree of press freedom a country's mass media system enjoys and the policy orientation each country has adopted toward biotechnology.

CHAPTER 3

METHODOLOGY

Data for this study were gathered by employing the combined method of secondary data analysis and content analysis.

3.1 Secondary Data

Other than the factors Scheufele (1999) enumerated as potentially influencing media frames, this study posits that the extent to which a country's mass media system is free to report issues, and the policy each country has adopted toward biotechnology (whether it is promotional, permissive, precautionary or preventive) will have a bearing on media frames. A country's policy posture toward biotechnology was ascertained by examining government pronouncements and official documents (i.e., from the Department of Agriculture, from legislatures and other specialized policy-making bodies, from national leadership pronouncements) regarding a nation's official stance on biotechnology.

The state of press freedom in the three nations was determined based on international indicators employed by Freedom House that publishes annual reports on the degree of democratic freedoms in each country in the world (Freedom House, n.d.). The report on the degrees of press freedom it issues annually is among the indices it provides in order to assess the current state of civil and political rights in each nation. The ranking is highly correlated with several other ratings of democracy also frequently used by researchers.

The independent variables for this study, therefore, were ascertained following an analysis of secondary data from other institutions.

3.2 Content Analysis

To assess media performance and measure newspaper-related variables, a content analysis of English-language newspapers published over a span of six years (from January 1, 2003 to December 31, 2006) was conducted. This timeframe covered the complete “lifespan” of the two GM issues in the three countries under study.

The articles analyzed included straight news reports, feature stories, editorial or editorial columns, and letters-to-the editor/newspaper about the GM rice and GM papaya issues across the three countries. These types of reports were included to represent the most comprehensive news information environment offered by a newspaper with respect to a particular topic.

In this study, the complete story—including the headline, the lead paragraph, and the entire text—was the unit of analysis.

The stories analyzed were drawn from a complete list (a complete enumeration) of articles about GM rice in the national and local English-language newspapers of China and the US, and about GM papaya in the national and local English-language newspapers of Thailand and the US. These articles were retrieved from an electronic search of stories in News Bank. This initial search was expanded by exploring the electronic archives and databases of English-language of the regional and local newspapers in Thailand and China, as well as those of the regional and local newspapers published in the US whose issues were not archived in News Bank.

In the three countries under investigation, a search was done for stories published from January 1, 2003 to December 31, 2006 from newspapers of national, regional and local circulation. The searches yielded a total of 481 articles: 91 stories on GM rice from China,

157 articles on GM rice from the US, 119 articles on GM papaya from Thailand, and 114 articles on GM papaya from the US.

3.3 Conceptual and Operational Definition of Variables

To address the research questions and test the hypotheses, the following variables need to be conceptually and operationally identified: (1) issue prominence, (2) pattern of coverage, (3) tone of coverage, (4) sources cited and (5) media frames.

The construction of meaning attached to an international event begins with a review of an issue or topic's prominence in news items. *Prominence* refers to the extent to which each GM crop topic generated newspaper space. Prominence was measured by determining (1) the number of articles published about the specific topic, and (2) the length of the stories in terms of the number of words per article. By measuring prominence, the answers to the first and second research questions that ask how intensely the Chinese, Thailand and the US newspapers reported on the genetic modification issues and the pattern of the Chinese, Thailand and the US newspapers' coverage of the genetic modification issues in each nation can be ascertained.

Pattern of coverage refers to the rise and fall in the number of media reports about a topic over time. Abbott and Lucht (2001) note the wild fluctuation in coverage of GMOs in the New York Times, the London Times and the London Daily Mail from 1997 to 2000 attributable to specific triggering events. Borah (2005) also observed a discernible fluctuation in the number of news reports about dowry in India through time. She also observed clear delineations of the pre-hoopla, hoopla and post-hoopla stages in the Indian newspapers' coverage of dowry as a long-running issue.

The overall *tone of the story* refers to the extent to which the article exhibits a positive or negative attitude toward each genetic modification incident. Other researchers have referred to this variable as valence (i.e., Boyle et al., 2005; Kioussis, 2004), an affective element of news. There are three kinds of tone a story might exhibit:

(1) A *positive* story is one in which the prevailing discourse suggests that genetic manipulation registers national strength, progress, and scientific advance. Specifically, a positive news item validates and justifies genetic engineering. For example, an article titled “Rice genetic code discovery key to hunger,” published in the China Daily on August 12, 2005, considers biotechnology as a solution to feeding the large Chinese population, equating it as a harbinger of a bright future for the country in general.

(2) A *negative* story is defined as one in which the overall tone or prevailing discourse suggests weakness, conflicts and problems related to genetic modification. Stories that are critical of genetic modification fall under this orientation. For example, an article titled “GMO contamination: Somsak urged to quit over papayas” from the Thai newspaper The Nation, published on September 30, 2004, questions the quality of genetically modified papaya and implies health risks.

(3) A *neutral* story is defined as one in which the prevailing discourse demonstrates either a balance between negative and positive elements or a mix of these two tones. It can also be an article that does not take any position regarding genetic modification. For example, the story titled “Genetically modified crops—Government promises public hearings on field testing,” published in Thailand’s The Nation on September 2, 2004, reports without any interpretation that government officials are set on conducting public hearings on the field

testing of genetically modified crops. Stories that are more event-oriented generally have this orientation.

Characterizing tone as “negative,” “neutral,” or “positive” provides the answer to the third research question which asks for the valence or orientation of articles.

The *sources* of information are persons, agencies, institutions or groups quoted by journalists in their reports. The selection of news sources not only divulges the media’s institutional biases but also reflects particular slants for or against issues, personalities or events (Herman, 1988). Bennett (1990) argues that the news media “tend to ‘index’ the range of voices and viewpoints in debates about a given topic” (p. 107). Abbott and Lucht (2001) observed a decline in the use of scientists as sources of information about GM topics published in the New York Times, the London Times and the London Daily Mail as coverage progressed. In the Philippines, the top three sources cited most by journalists in their reports about GM foods from 2000 to 2004 were government, non-government organizations and business/industry representatives (Mula, 2006). Based on these previous studies, attributions were categorized as coming from the following sources following the categorization scheme used by Abbott and Lucht (2001):

- (1) Scientists from universities and university-based research institutions (e.g., scientists from the Chinese Academy of Sciences);
- (2) Government scientists (e.g., scientists from the Chinese or Thai Ministry of Agriculture);
- (3) Other scientists (scientists from institutions other than those mentioned above);
- (4) Scientific journals and journal editors;

- (5) Industry, industry associates, wholesalers (e.g., Pioneer Hi-bred, Monsanto, Hawaii Papaya Growers Association);
- (6) Ordinary citizens and consumers, but not farmers;
- (7) Advocacy groups (e.g., Greenpeace, Union of Concerned Scientists, The Sierra Club);
- (8) International not-for-profit groups (e.g., the United Nations and its affiliate agencies) but not Greenpeace and the like;
- (9) Politicians and government employees, but not government scientists;
- (10) Farmers and farmers associations; and
- (11) Others, including religious leaders.

As Entman (1993) explained, “to frame is to select some aspects of a perceived reality and make them more salient in a communicating text in such a way as to promote a particular problem definition, causal interpretation of events and news in the mass media” (p. 56). *News frames* in this study refer to the (1) general ways by which the news stories were constructed, which is mainly reflected in the story themes, and (2) the value judgments used for problem definition, moral evaluation and treatment recommendation manifest in story content (Peng, 2004). Based on the categories found in previous studies (i.e., Peng, 2004; Mula, 2006) the news frames used in this study were categorized as:

- (1) The political frame: This frame chiefly reflects the government’s political agenda, such as its policy about GM crops and biotechnology regulation.
- (2) The economic frame: This frame emphasizes the economic impact of GM crops and genetic modification. It includes investments in GM crops research and the profits

accruing from GM crops. As a result of globalization, GM crops, as products for trade, also may be considered an international economic issue.

(3) The religious, moral or ethical frame: This frame stresses religious, moral and ethical concerns about genetic modification. This includes stories that question scientists' "tinkering with nature," the ethical dilemmas policymakers face as they balance the imperatives of food production and environmental protection, the moral obligation to feed the hungry, and religious beliefs about people's control over plant genes, among others.

(4) The scientific frame: This frame reflects scientifically-based arguments and logic in support of or in opposition to genetic modification. Stories exhibiting this frame are those that provide empirical evidence to support or reject a claim or a counter-claim.

(5) The environmental frame: This frame emphasizes the environmental effects of genetically engineered crops, such as gene flow and the potential cross-pollination of GM and organic crops, and concerns about threats to biodiversity. Cleaner air, as a consequence of reduced pesticide spraying, is also included in this frame.

(6) Others: This includes frames and topics not mentioned above.

3.4 Data Analysis

Research Question 1, which compares intensity of coverage between nations based on a single issue was answered using frequency distribution data.

Research Question 2 asks: What was the within-country pattern of this coverage? Is there any difference among the countries in terms of pattern of coverage? These questions were answered by comparing charted frequency distribution data.

Research Question 3, which asks for orientation of stories, was answered using descriptive statistics. To determine if there is between-country difference, two independent 2 x 3 chi-square tests were conducted.

Hypothesis 1, which posits that government sources will be cited the most in the three countries' media coverage of these GM incidents, was tested by running two separate chi-square tests for the two pairs of countries under study.

Hypothesis 2, which posits a difference in frames across nations, was tested using two separate chi-square tests for the two pairs of countries involved.

Hypothesis 3 posits that the framing of GM events will be a function of (a) the degree of press freedom a country's mass media system enjoys and (b) the policy orientation each country has adopted toward crop biotechnology. This two-part hypothesis was tested using chi-square and analysis of variance tests.

3.5 Reliability Testing

Two independent coders, both journalism graduate students, were involved in the coding work. A coding manual was discussed and agreed upon by the two coders. The coding scheme was tested on 10% of the stories collected for analysis. Inter-coder reliability was computed using Holsti's (1969) reliability formula, $CR = 2(M) / (N1 + N2)$, where M is the number of times the coders agree, and N1 and N2 represent the total number of coding decisions made by each coder. The results of reliability testing for each of the variables of interest in this study are shown in Table 2. As Table 2 shows, the reliability values for all nominal variables were acceptable.

Table 2. Inter-coder reliability results

Variable	Inter-coder reliability (%)
Tone of Chinese newspapers regarding GM rice	88.9
Tone of US newspapers regarding GM rice	75.0
Tone of Thai newspapers regarding GM papaya	86.5
Tone of US newspapers regarding GM papaya	72.7
Frames in Chinese coverage of GM rice	92.2
Frames in US coverage of GM rice	80.6
Frames in Thai coverage of GM papaya	83.5
Frames in US coverage of GM papaya	81.8
Sources cited in Chinese coverage of GM rice	97.0
Sources cited in US coverage of GM rice	91.4
Sources cited in Thai coverage of GM papaya	94.9
Sources cited in US coverage of GM papaya	89.7

CHAPTER 4

RESULTS AND DISCUSSIONS

A total of 481 stories were retrieved from News Bank and the electronic searches of the archives of English-language newspapers in China, Thailand and the US. Of these, 298 were straight news reports, 101 were feature stories, 48 were editorial pieces and 34 were letters to the editor or newspaper. Three hundred and one newspapers in this study were circulated on a national scale; 180 can be considered as regional or local newspapers.

4.1 Issue Prominence

Compared to the coverage of regular non-controversial science issues, the newspapers' coverage of the two GM events in the three countries over a span of six years (2001-2006) can be characterized as medium in terms of intensity.

GM rice was more heavily reported by the US press. In the American media, it was the subject of 157 newspaper articles (whose average length was 863 words) over six-years. The topic received less attention in the Chinese press, which published 91 articles about it in six years, the lightest coverage among the four GM events analyzed. The Chinese articles compare favorably with the American stories in terms of average length (872 words) (Figures 2 and 3).

GM papaya received almost equal attention from the US and Thai newspapers. Thailand produced 119 articles about GM papaya, five more than its American counterparts, but the average length of its stories (546 words) were shorter than the American reports that were, on average, 725 words in length.

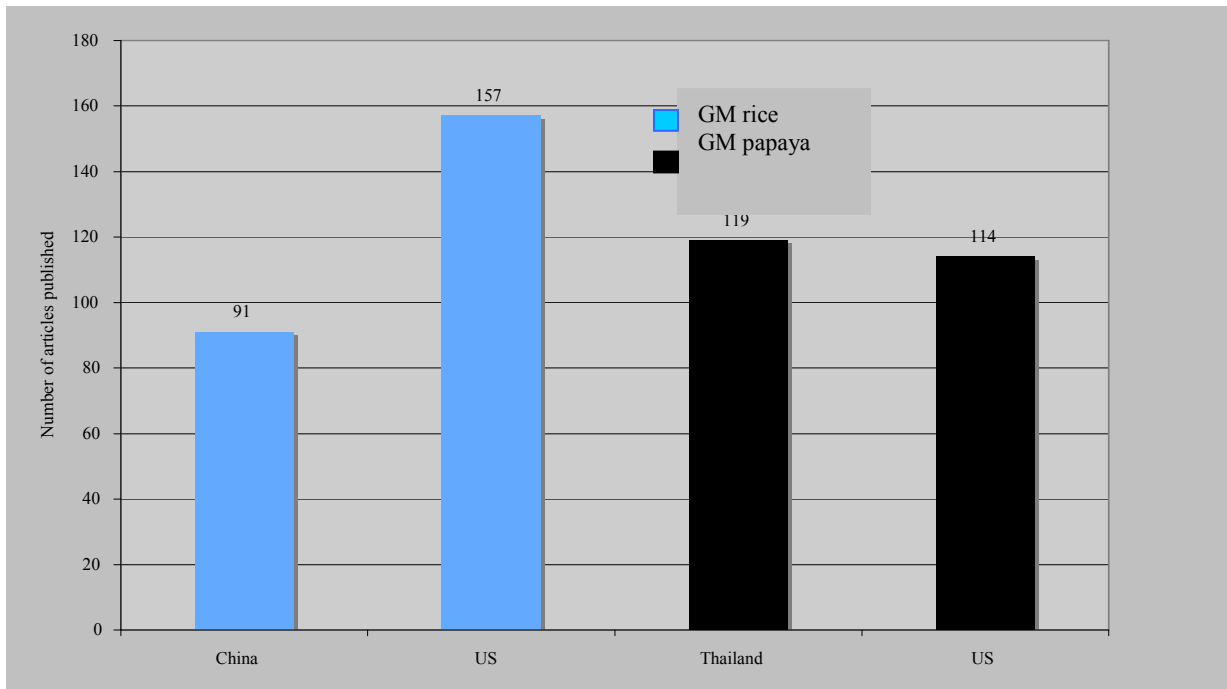


Figure 2. Prominence of coverage in terms of number of stories published per country

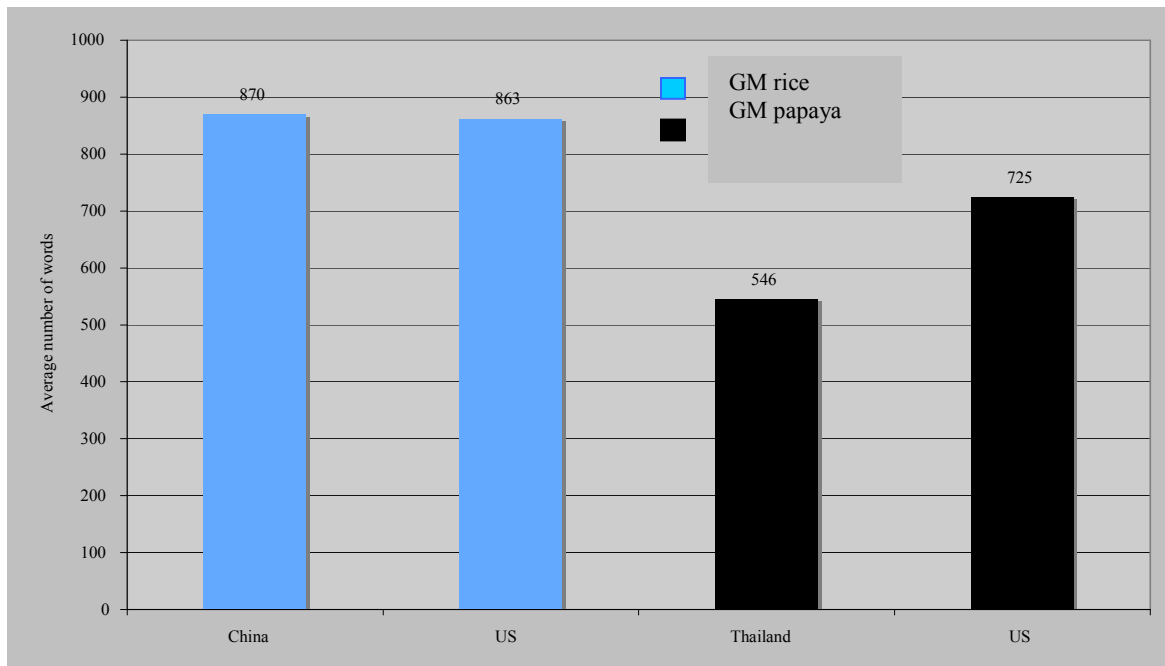


Figure 3. Length of stories in terms of number of words

4.2 Patterns of Coverage

In order to determine patterns of coverage, the number of GM stories published in each country was plotted against time. As Figure 4 shows, there were discernible peaks and valleys in intensity of coverage across time in all four events. The spikes evident in the line graphs indicate instances when triggering events may have spurred newspaper coverage.

A hoopla effect can be detected in the Chinese coverage of GM rice, which was generally low from 2002 to 2003 (two to three stories), rose gradually to 14 in 2004, and then swelled to 46 in 2005. It dropped dramatically to 26 articles as the issue apparently lost steam in 2006. An analysis of the coverage indicated that the spike in news reports was ushered in by the agricultural scientists' December 2004 report to the central government outlining the benefits of commercializing GM rice. The official report, however, was immediately followed by Greenpeace's accusation, issued in March 2005, that Heinz, a global US-based food company, was selling baby food containing GM rice which was not yet allowed in the Chinese market. In April 2005, illegal GM rice was found to sell in some local markets. These incidents alerted journalists to the issue and to most advocacy groups' concerns about the safety and management of genetically altered foods (Figure 4).

As Figure 4 shows, US newspaper coverage of GM rice was well into its upswing in 2005, and received greatest publicity in 2006 with 77 stories, the highest registered in this seemingly struggling coverage. The advent of Vitamin E-fortified golden rice attracted and kept the media's attention from 2001 to 2003, but the finding that US commercial long-grain rice exports were contaminated with genetically engineered rice unapproved for human assumption in August 2006 shifted the coverage on over-drive that year. As a response, the

EU and Japan temporarily suspended US long-grain rice imports and then ordered strict controls, which caused a steep decline in the price of rice.

A hoopla effect also can be detected in the Thai coverage of GM papaya, which was generally low from 2001 to 2002, rose dramatically to 60 stories in 2004, and then fell precipitously to 16 articles in 2005. An analysis of the coverage content indicates, once more, that story intensity was amplified by Greenpeace's accusation that Thai agriculture officials were deliberately selling GM papaya seeds to farmers in the province of Khon Kaen. In response, government officials held media conferences to clarify their actions in the province. This brought a spike in coverage in the later half of 2004. Subsequently, Greenpeace blamed Department of Agriculture officials for failing to curtail gene flow from its experimental stations, a move that piqued the media's attention anew. In another development, the Cornell University Research Foundation, working with the Agriculture Department, moved to patent the papaya ring spot virus' DNA structure. Greenpeace responded by publicly warning farmers and researchers that they will soon pay for the use of genes and seeds developed using the patented techniques. This added to the wave of media coverage evident in 2006 (Figure 4).

The US coverage of GM papaya did not undergo such drastic ebbs and flows. In the US, coverage of GM papaya was relatively flat, aroused only somewhat in 2004 (a six-year high of 33 stories) when organic papaya farmers in Hawaii marched to protest the alleged contamination of their organic plantations with GM seeds. They claimed they have suffered losses, as it is difficult to guarantee the GE-free status of their crops due to contamination from neighboring commercial GE farms. Even that, however, failed to bring drastic fluctuations in coverage (Figure 4).

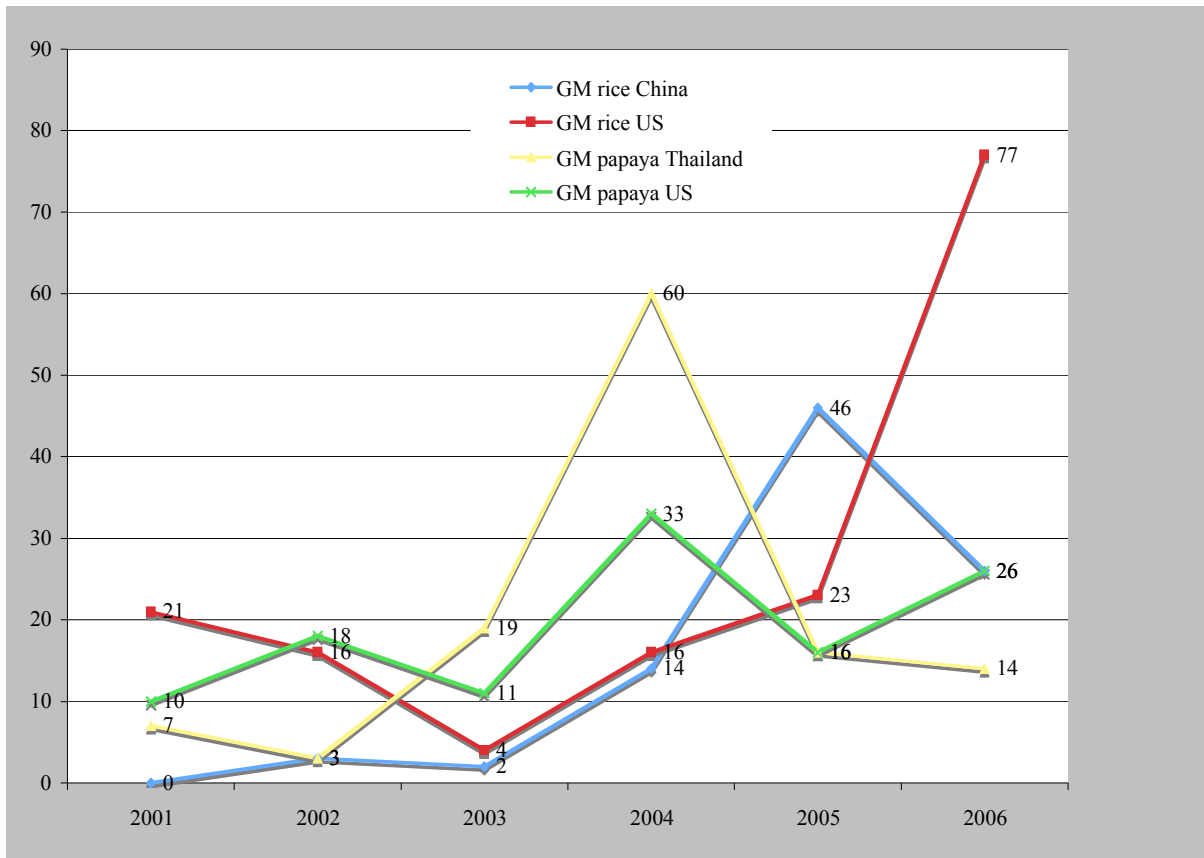


Figure 4. Pattern of coverage of GM rice and GM papaya in countries

4.3 Tone of coverage

Research Question 3 asks about the tone of the coverage of the GM event in each country. Tone refers to the general orientation of the story with respect to genetic engineering, where 1 means “negative,” 2 means “neutral” and 3 means “positive.” As Figure 5 indicates, newspaper coverage of the two GM issues in the three countries did not show a positive orientation toward the innovations at any time. The US and Thai press held similar negative attitudes or tones toward GM papaya although the Thai coverage was decidedly more negative than that of the US. While there is an observable difference in the press’s attitude toward GM rice between the US and China, the Chinese newspapers demonstrated extreme or polar attitudes toward GM rice (Table 3). Forty-seven articles were patently

negative toward GM rice, 25 were positive, and only 19 stories fell under the neutral category (26% of the total). Compared to its Chinese counterparts, the US newspapers tended to report events in a “balanced” way, producing 60 articles that were neutral toward GM rice, about 40% of the total number of articles. The extreme values exhibited by the Chinese newspapers reinforce the observation that today’s journalists are enjoying comparatively free space when discussing relatively non-political subjects. The prominence of neutral stories echoes previous findings that the US media reports on science topics generally reflect the journalistic tenet of balanced reporting and fair coverage as exemplified by the presence of various opinions and points of view.

Table 3. Descriptive statistics for the tone of coverage in the three countries

	N	Mean	Std. dev.
China (GM rice)	91	1.76	.861
The US (GM rice)	157	1.71	.734
Thailand (GM papaya)	119	1.62	.748
The US (GM papaya)	114	1.75	.793

When plotted across time, the stories’ attitude at the beginning of the coverage in each of the three countries is less negative than the attitude of stories published at the tail-end of this study’s timeframe. From January to June 2001, the mean of the tone of coverage for GM rice in the US is 1.88, almost neutral; in China the stories were initially neutral to slightly positive (mean=2.5). The mean of the tone of coverage for GM papaya in the US was 1.71; in Thailand, it was 2.33. As Figure 6 indicates, although there are fluctuations in tone of coverage, the overall trend was to be more negative. From July to December 2006, the mean of the tone of coverage for GM rice in the US was 1.41; for China, it was 1.82. Stories about GM papaya in the US registered a mean tone of coverage of 1.16; Thailand, on the other hand, was particularly negative (mean=1) (Table 3).

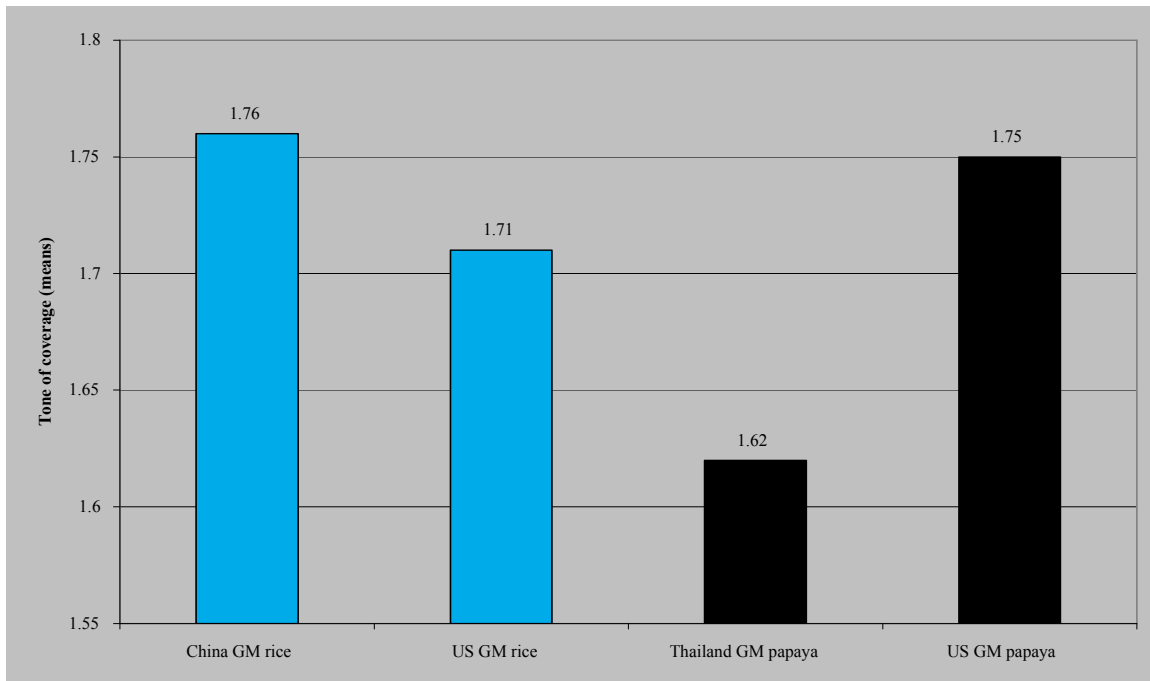


Figure 5. Means of tone of coverage for the GM event in each country. Tone was measured on a scale of 1 to 3, where 1 = “negative”, 2 = “neutral” and 3 = “positive”.

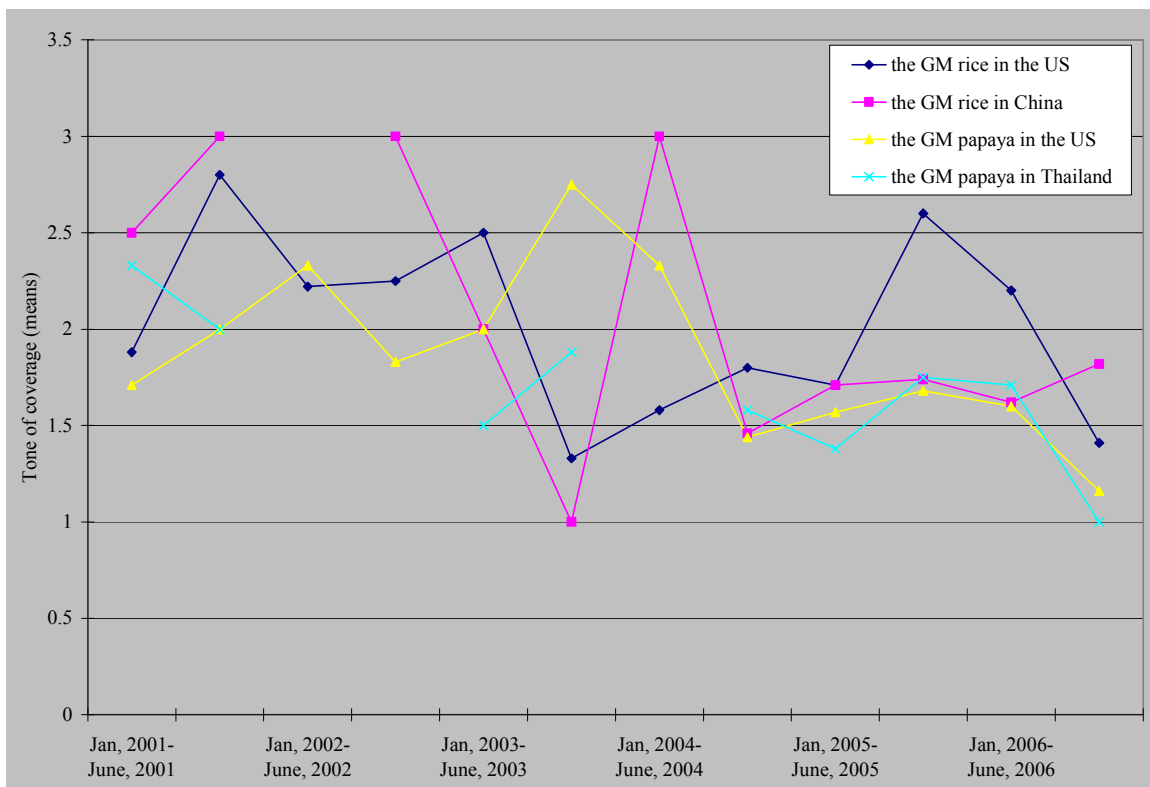


Figure 6. Means of the tone of coverage for GM events in the three countries over time

The results of a chi-square test showed a significant difference between the Chinese and the US newspapers' coverage in terms of their attitude toward GM rice [$X^2(2) = 9.27$, $p < .05$]. As Table 4 shows, there were more negative to neutral articles in the Chinese newspapers' coverage of GM rice than the US newspapers' coverage. As Table 5 shows that although there were more negative articles in the Thai newspaper stories about GM papaya than the US newspaper stories and there were more positive articles in the US newspaper stories about GM papaya than the Thai newspaper stories, they were not significantly different from the US reports regarding their attitude or tone [$X^2(2) = 1.75$, $p > .05$]. Moreover, the US newspapers and the Thai newspapers have the same number of neutral stories of GM papaya.

Table 4. Chi-square test comparing the difference between the US and China in terms of the tone of the newspapers' GM rice coverage

	US	China	Chi-square	df	Asymp.Sig (2-sided)
Negative	71	47	9.27	2	.010
Neutral	60	19			
Positive	26	25			
Total	157	91			

Table 5. Chi-square test comparing the difference between the US and Thailand in terms of the tone of the newspapers' GM papaya coverage

	US	Thailand	Chi-square	df	Asymp.Sig (2-sided)
Negative	53	64	1.75	2	.418
Neutral	36	36			
Positive	25	19			
Total	114	119			

4.4 Sources cited

Hypothesis 1 posits that government sources will be cited the most in the three countries' media coverage of these GM incidents and that in the US, industry sources will also be cited heavily because of their connectedness to GM issues. As Figure 7 shows, the three sources most frequently cited in the US newspapers' coverage of GM rice were

industry representatives, politicians and advocacy groups, in that order. The top three sources cited in the Chinese reports were advocacy groups, politicians and scientists in universities or university-based research and scientific institutions, in descending order. As Figure 8 shows, in the US reports about GM papaya, advocacy groups, farmers and politicians were the top three most frequently cited sources (in that order). The three major sources cited by the Thai newspapers in covering GM papaya were advocacy groups, politicians and scientists, in descending order.

As Figure 9 shows, in the beginning, university scientists and industry sources were cited the most in the Chinese coverage of GM rice. Gradually, politicians, advocacy groups and ordinary citizens increased their presence to become the top two sources cited. In the hoopla period (when university scientists came out in support of the commercialization of GM rice), advocacy groups, politicians and university scientists were the three major players in media coverage. Unlike in the US, however, where politicians were cited the most in the hoopla period, advocacy groups took control of the hoopla period according in China.

Initially in the US, scientists and industry representatives were cited most frequently in the newspapers' coverage of GM rice. During this period that saw the advent of golden rice, the innovation was generally lauded, mostly by scientists, as a major solution to hunger and Vitamin A deficiency among children in many parts of the world for whom rice is a staple crop. At this juncture, therefore, the tone of coverage tended to be neutral. When the contamination controversy erupted that triggered the identified hoopla period in 2006, the range of voices featured in the articles expanded to include ordinary citizens, advocacy groups, farmers and government scientists. And more forceful were the opinions from the

industry representatives and politicians, the top two sources cited at the peak periods of coverage (Figure 10).

In Thailand, politicians and advocacy groups dominated the whole coverage period (Figure 11). In fact, advocacy groups were in control in all phases of the coverage, including the hoopla period.

As the pattern of media coverage suggests, the US coverage of GM papaya did not undergo drastic ebbs and flows. It was relatively flat, aroused somewhat only in 2004 when organic papaya farmers in Hawaii marched to protest the alleged contamination of their organic plantations with GM seeds. During this hoopla period, farmers, advocacy groups and politicians were the major players in the media coverage (Figure 12). Across the three nations, advocacy groups dominated the discourse about the GM issue. The hypothesis, therefore, was not supported.

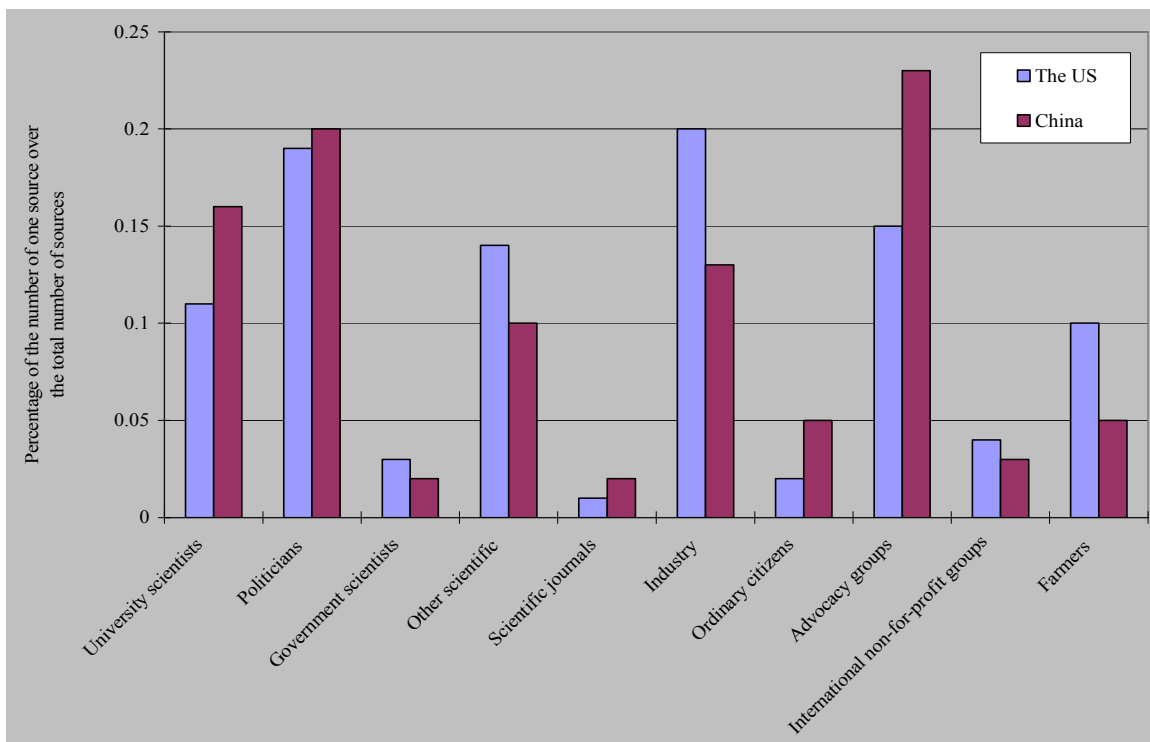


Figure 7. Categories of sources cited in the Chinese and US coverage

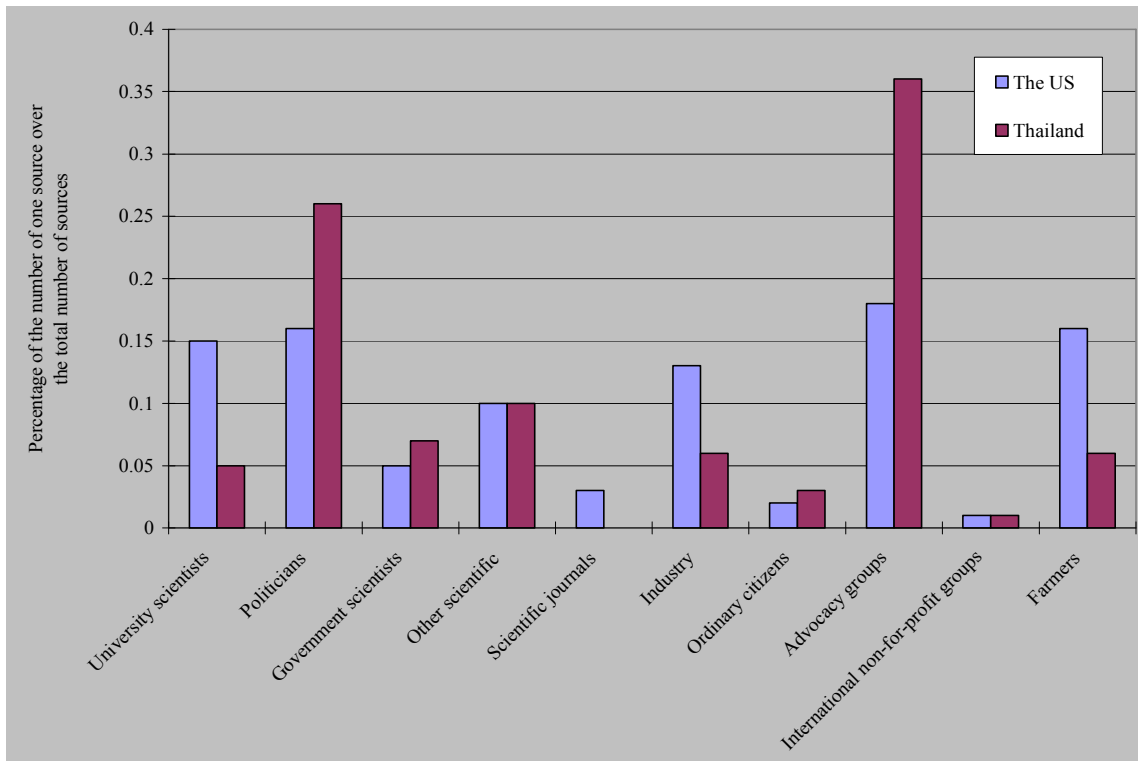


Figure 8. The categories of sources cited in the Thai and US coverage

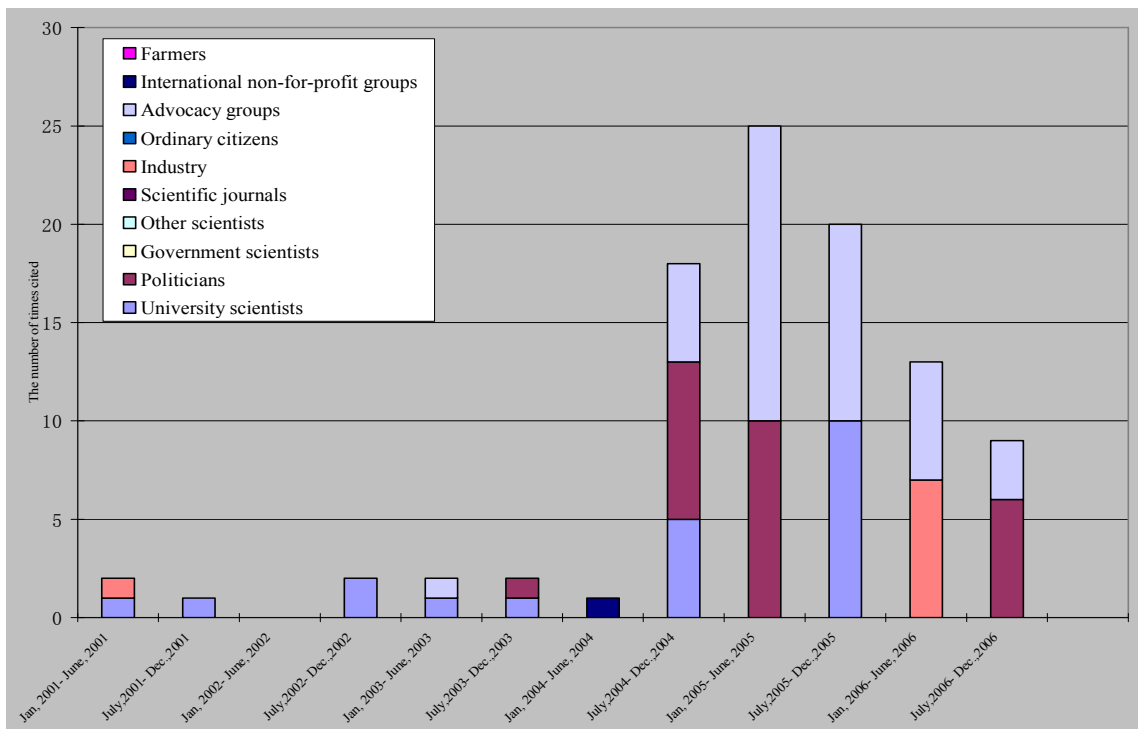


Figure 9. The top two sources cited in the Chinese coverage over time

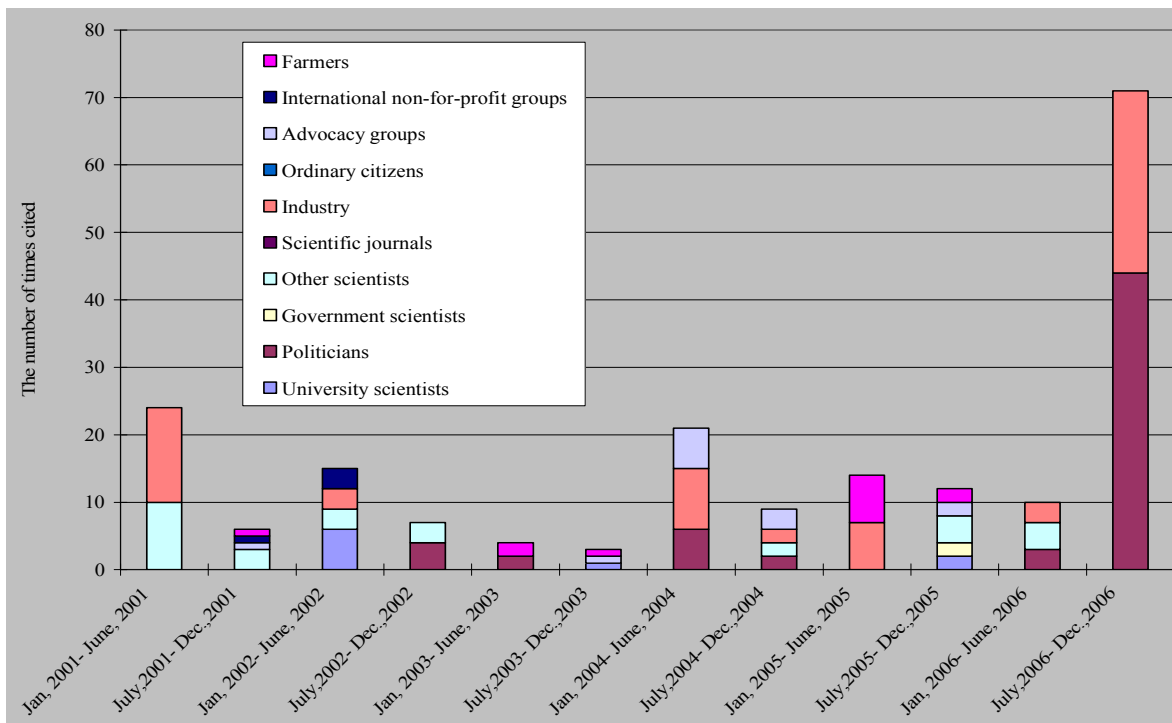


Figure 10. The top two sources in the US coverage of GM rice over time

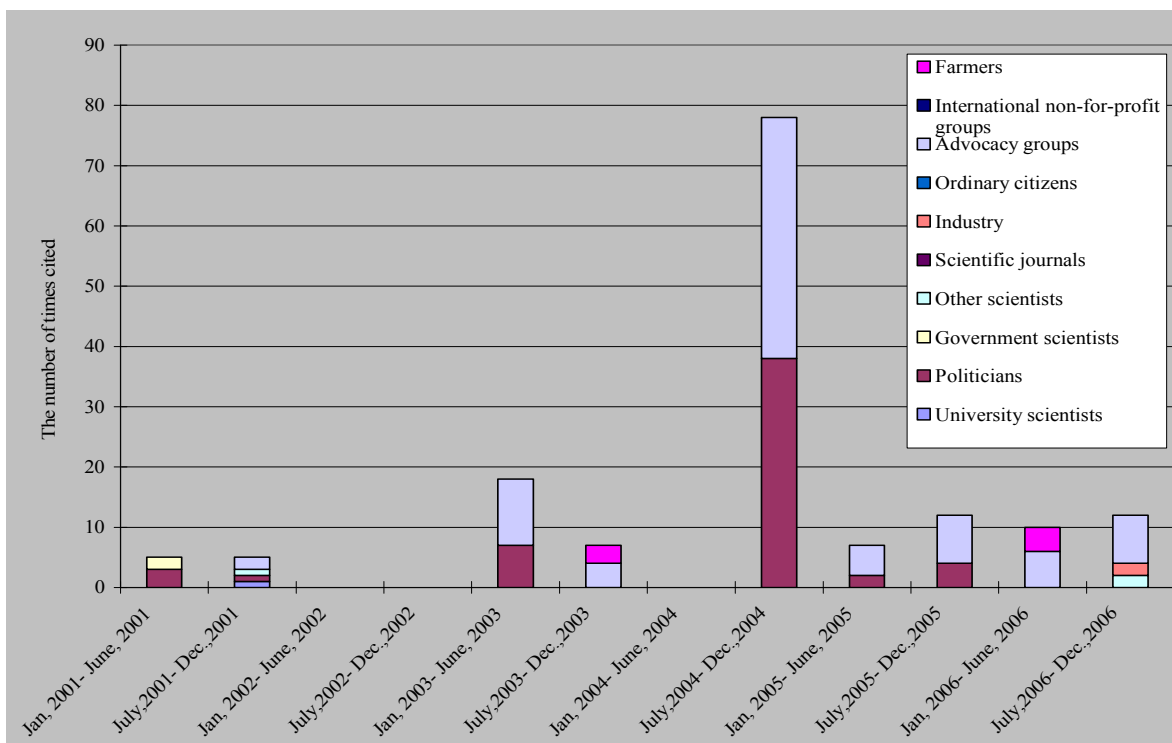


Figure 11. The top two sources cited in the Thai coverage over time

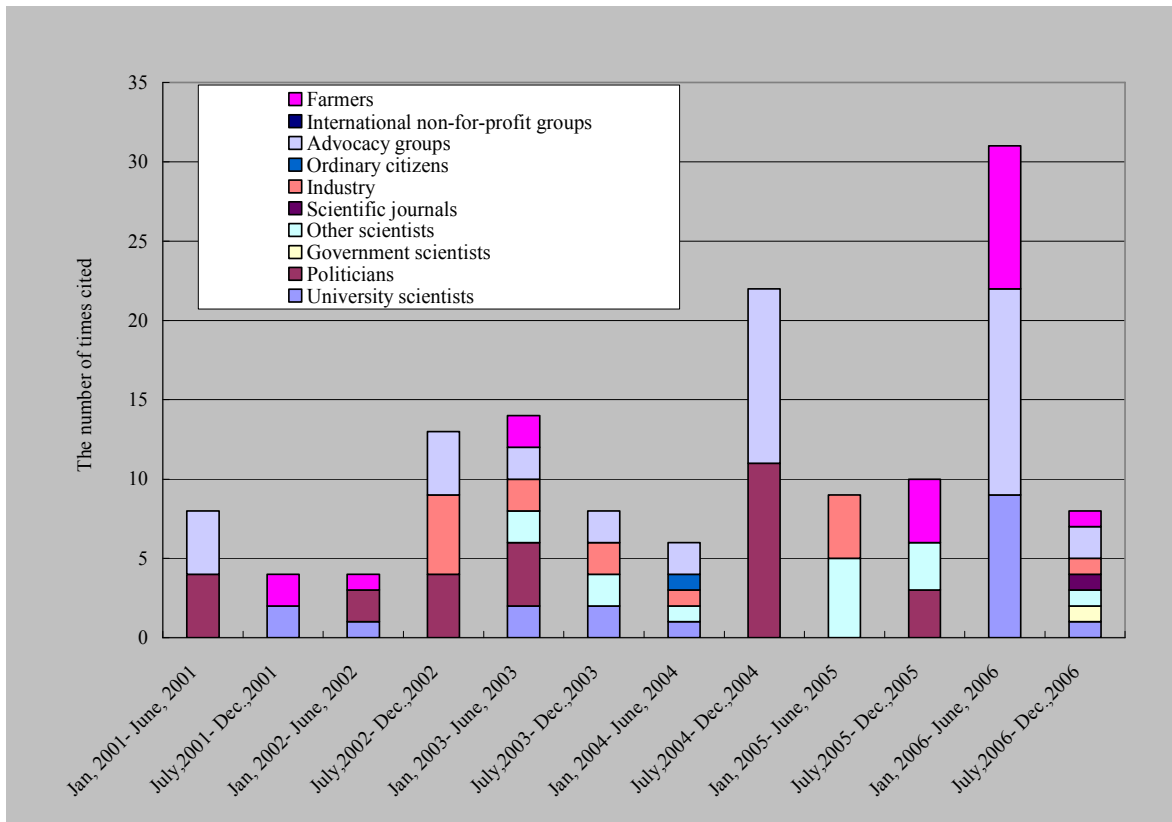


Figure 12. The top two sources in the US coverage of GM papaya over time

A chi-square test was conducted to compare the frequency with which the various sources were cited in the US and Chinese coverage of GM rice. A significant difference was found between the US and China in terms of the number of times they cited other scientists [$X^2(1) = 5.51, p < .05$], industry representatives [$X^2(1) = 5.51, p < .05$] and farmers [$X^2(1) = 5.93, p < .05$] as sources. That is, the US was more likely to cite other scientists (53 out of 376), industry representatives (75 out of 376) and farmers (37 out of 376) as sources than the Chinese reports (Table 6).

Table 6. Results of chi-square tests conducted to compare the US and China in terms of the frequency of categories of sources

	US	China	Chi-square	df	Asymp. Sig (2-sided)
University scientists	43	30	.863	1	.353
Politicians	73	36	1.125	1	.289
Government scientists	12	3	.166	1	.166
Other scientists	53	18	5.51	1	.019
Scientific journals	4	4	.630	1	.427
International non-for-profit groups	8	10	.085	1	.085
Ordinary citizens	8	10	2.973	1	.085
Advocacy groups	56	42	2.650	1	.104
Industry	75	23	12.20	1	.000
Farmers	37	10	5.93	1	.015

Table 7. Results of chi-square tests conducted to compare the US and Thailand in terms of the frequency with which categories of sources were cited in their coverage of GM papaya

	US	Thailand	Chi-square	df	Asymp.Sig (2-sided)
University scientists	35	11	16.92	1	.000
Politicians	38	61	7.66	1	.006
Government scientists	13	16	.223	1	.637
Other scientists	25	23	.241	1	.623
Scientific journals	6	0	6.43	1	.011
International non-for-profit groups	3	2	.251	1	.617
Ordinary citizens	5	8	.603	1	.437
Advocacy groups	43	85	26.72	1	.000
Industry	32	13	10.98	1	.001
Farmers	39	14	16.69	1	.000

Another chi-square test was conducted to compare the frequency with which the various sources were cited in the American and Thai coverage of GM papaya. As Table 7 shows, there were significant differences between the US and Thai newspapers in terms of the frequency with which they attributed statements, ideas and opinions to politicians [$\chi^2 (1) = 7.66, p < .05$], scientific journals [$\chi^2 (1) = 6.43, p < .05$], industry representatives [$\chi^2 (1) = 10.98, p < .05$], advocacy groups [$\chi^2 (1) = 26.72, p < .05$] and farmers [$\chi^2 (1) = 16.69, p < .05$]. That is, the American newspapers were more likely to make attributions to scientific journals (6 out of 239), industry representatives (32 out of 239) and farmers (39 out of 239) than their counterparts in Thailand. On the other hand, the Thai newspapers were more likely to use politicians (61 out of 233) and advocacy groups (85 out of 233) as sources.

The findings indicate that the US newspaper coverage of GM rice was rife with conflict between industry representatives and farmers. This was apparent especially when organic farmers placed the blame squarely on Bayer, a biotechnology company, for the decline in rice prices as a consequence of the GM contamination of their rice exports. In Thailand, Greenpeace and other advocacy groups were at loggerheads with the government over what Greenpeace calls “genetic pollution.” It accused Prime Minister Thaksin Shinawatra of bowing to pressure from US corporate giants like Monsanto, which were seen as pushing the country to reverse a ban on its field trials of GM papaya.

4.5 Frames Employed

What were the most commonly employed frames in the three countries’ portrayal of their respective GM events? Hypothesis 2 posits that in the Chinese and American press, the economic frame will be used the most while in the Thai papers, the political frame will be the most dominant.

As Figure 13 shows, the US newspapers used the economic frame most frequently in reporting about GM rice. Of the five frames observed, the economic frame was most evident mainly because of the discovery that commercial long-grain rice bound for the European Union was contaminated with genetically engineered rice yet unapproved for human consumption. The fall-out from this incident in terms of the price of US rice drastically moved the coverage toward a more economic orientation. In the Chinese press, the scientific frame dominated the coverage when government scientists countered Greenpeace's negative appraisal of GM rice, citing that biotechnology can cut national pesticide expenditures and assure bumper harvests. Next most frequently deployed were the political frames as government leaders began discussing the potential benefits accruing to the nation from GM rice. The religious and moral frame did not appear in the Chinese coverage and was the least used framework of discussion overall. In the newspapers' coverage of GM papaya, the US capitalized on the scientific frame, while the Thai newspapers mainly used the political frame (Figure 14). In Thailand, the political frame took hold when Ministry of Agriculture officials faced the advocacy groups' scrutiny regarding genetic cross-contamination. As the Prime Minister ordered strict controls over GM papaya trials, the European Union issued a ban on Thai papayas, and farmers feared enormous economic loss. In the US, the use of the scientific frame was inevitable as science reporters endeavored in their stories to explain the menace brought about the papaya ring spot virus and the mechanisms of gene flow.

In the Chinese newspapers' coverage of GM rice, the economic frame was almost non-existent during the initial part of the study period. But in the hoopla period when scientists started to advocate for the commercialization of GM rice, economic frames became

dominant as more stories discussed the government's research investments on GM rice and the potential economic gains it can provide to farmers (Figure 15).

As Figure 16 illustrates, in the US newspapers' coverage of GM rice, the scientific frame appeared was always one of the top two frames at every phase of the coverage. It was, however, dislodged during the hoopla period, replaced by economic and political frames.

In the Thailand newspapers' coverage, at the beginning, the top two frames were economic and environmental as articles reported on the cost and benefits of GM papaya and its environmental effects. In the hoopla period, however, the scientific and the political frames became the most dominant (Figure 17), especially since Greenpeace relied mostly on science-based arguments to oppose the government's pro-GM policy.

In the US newspapers' coverage of GM papaya, before the hoopla period, the economic, environmental, political and scientific frames were the most commonly employed. But in the hoopla period, when organic papaya farmers in Hawaii marched to protest the alleged contamination of their organic plantations, the scientific, environmental and economic frames were most frequently applied (Figure 18). There were major concerns about the environmental effects and safety of GM papaya and potential export losses. Therefore, the hypothesis was supported only for the US coverage of GM rice, which displayed more economic frames, and the Thai coverage of GM papaya, which was replete with political frames.

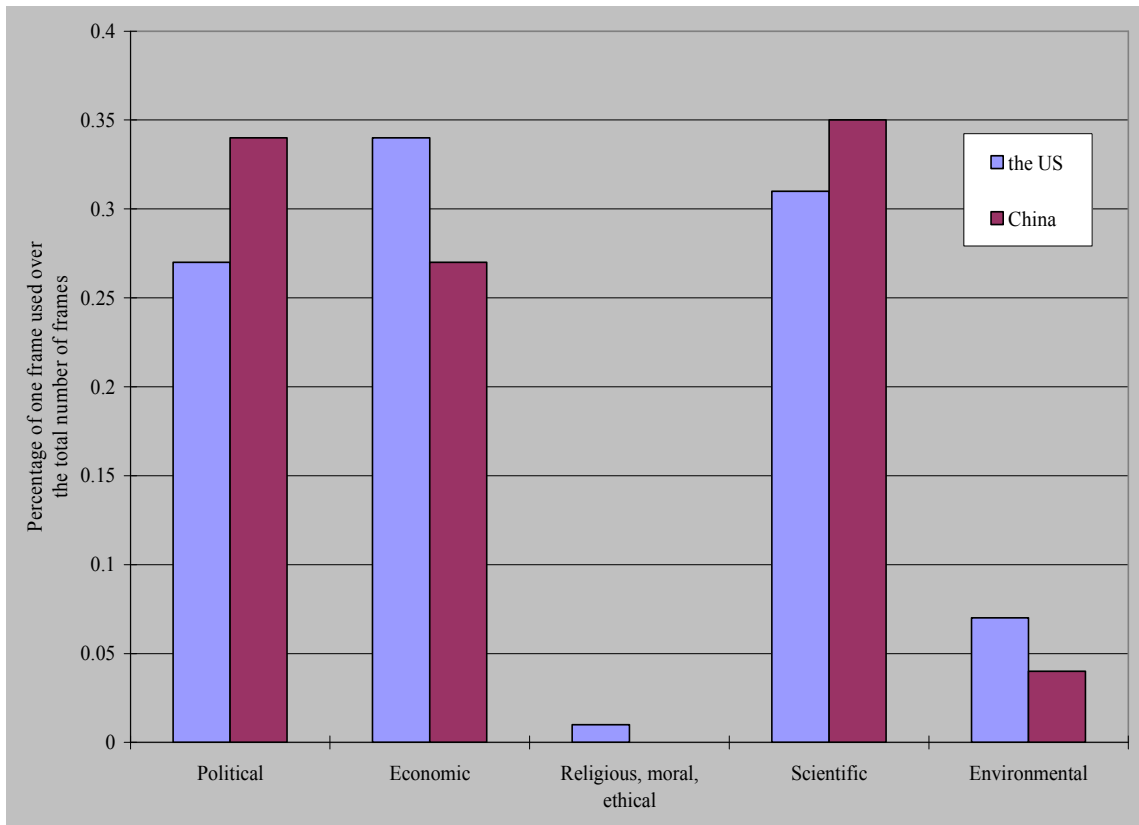


Figure 13. Frames employed in the Chinese and US coverage of GM rice

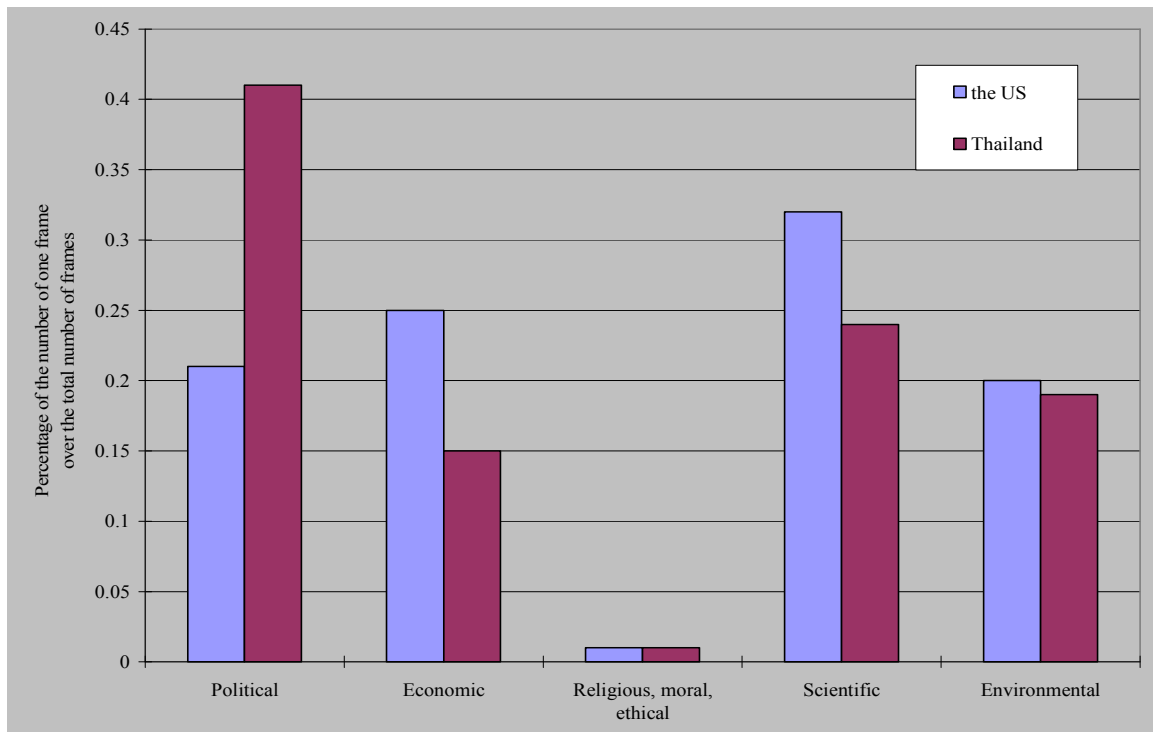


Figure 14. Frames employed in the Thai and US coverage of GM papaya

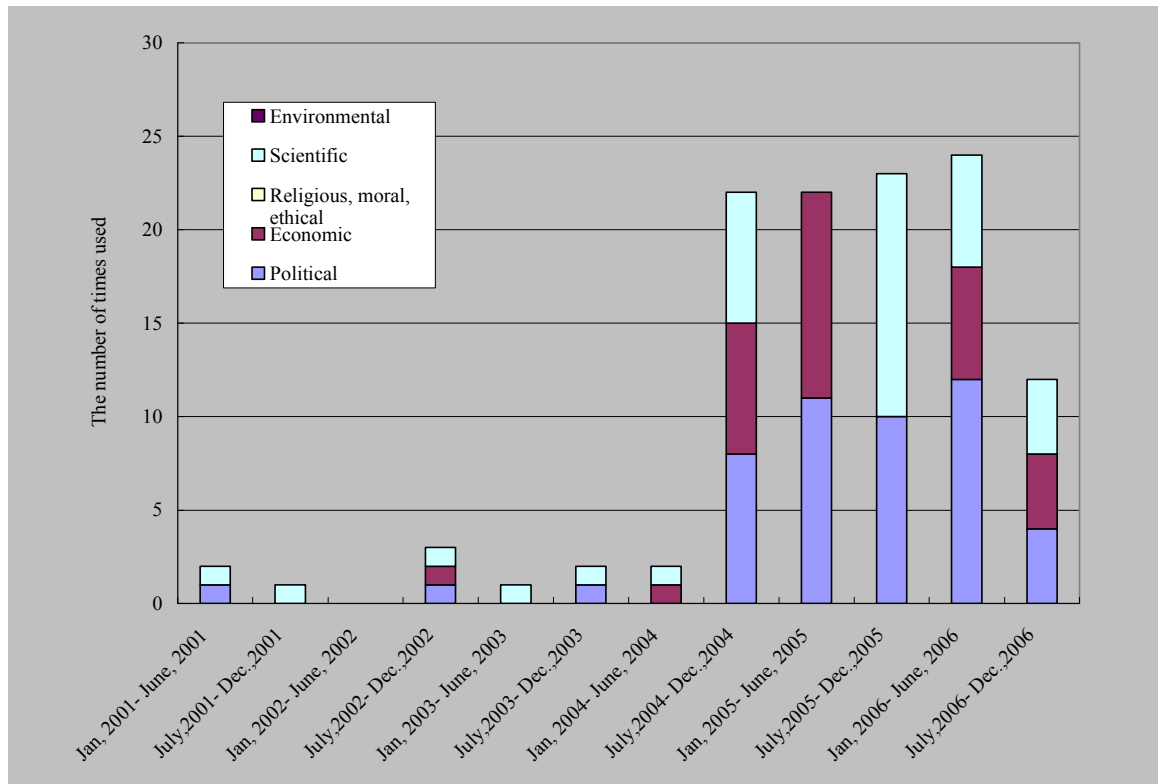


Figure 15. The top two frames employed in the Chinese coverage over time

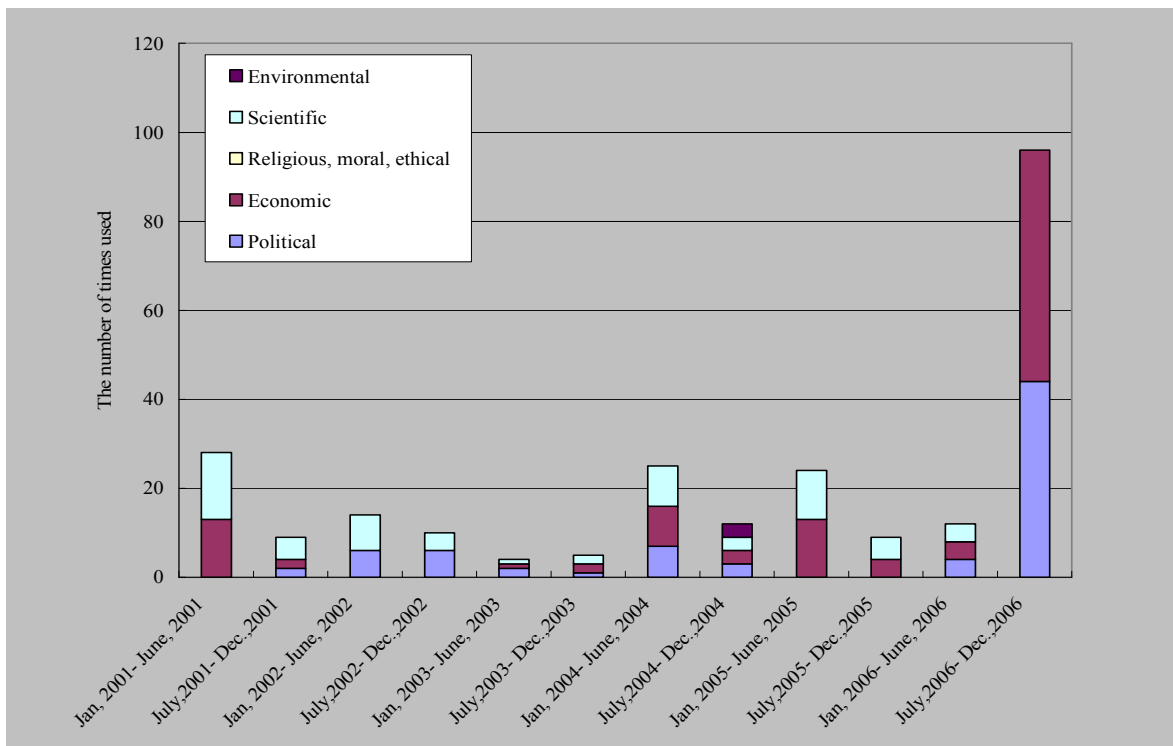


Figure 16. The top two frames in the US coverage of GM rice over time

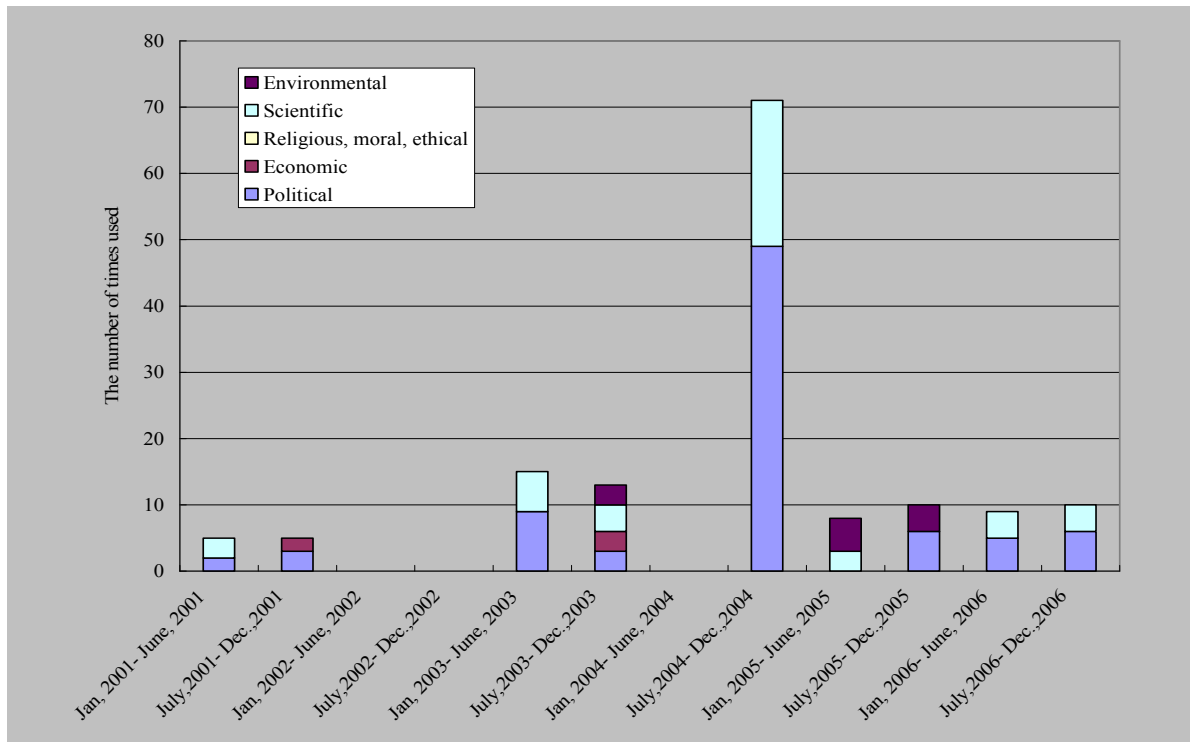


Figure 17. The top two frames employed in the Thai coverage over time

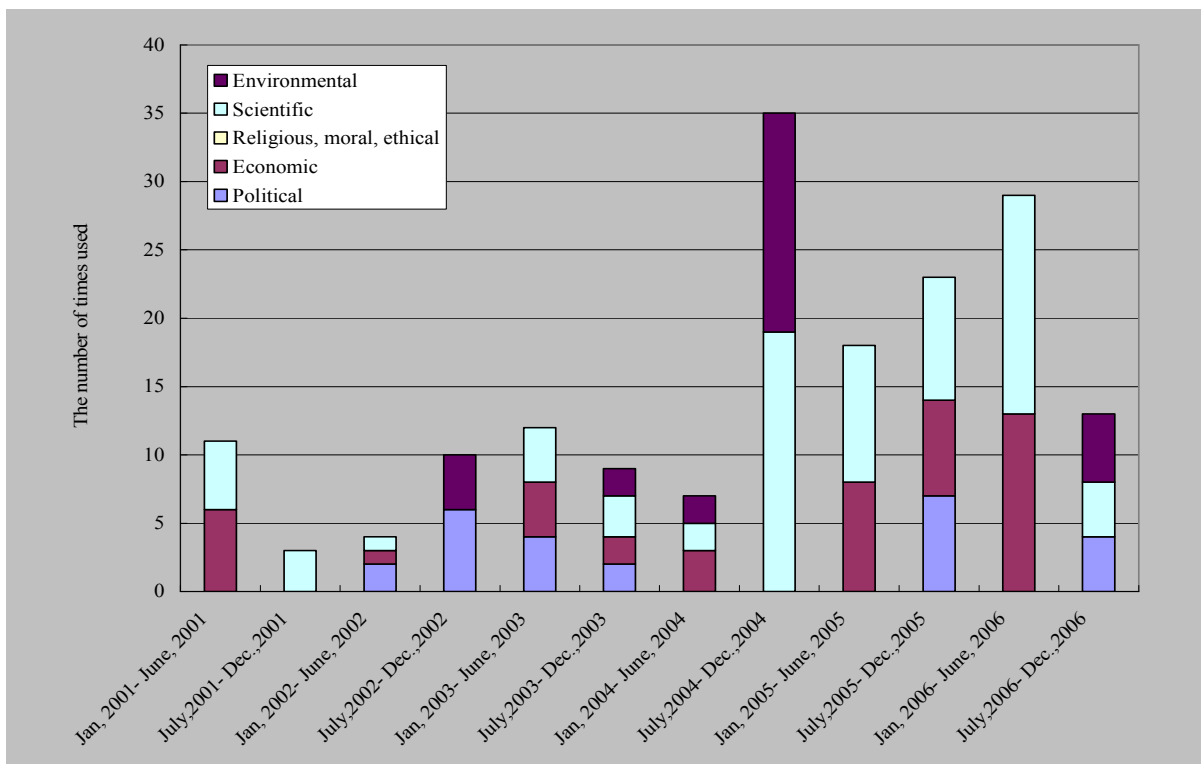


Figure 18. The top two frames in the US coverage of GM papaya over time

Two chi-square tests were conducted to determine whether the two pairs of countries differed in terms of frames applied in their discussion of their respective GM issues. The results shown in Table 8 indicate that the US and Chinese newspapers were different in their use of the economic frame [$X^2 (1) = 19.14, p < .05$] and the environmental frame [$X^2 (2) = 4.59, p < .05$]. That is, the US newspapers were more likely to use the economic frame (113 out of 334) and the environment frame (25 out of 334) than the Chinese papers. The primacy of rice as a staple and export product in countries was driving the use of the two frames.

The US and Thailand newspapers also differed in their use of the political frame [$X^2 (1) = 14, p < .05$], the economic frame [$X^2 (1) = 20.56, p < .05$] and the scientific frame [$X^2 (1) = 21.07, p < .05$]. In this case, the US newspapers were more likely to use the economic and scientific frames, while the Thai newspapers were more likely to employ the political frame (Table 9). The presence of loud and aggressive advocacy groups in the Thai coverage that hammered the government on scientific and economic fronts paved the way for the journalists' deployment of these three frames.

Table 8. Results of chi-square tests comparing China and the US in terms of frames employed in their newspapers' GM rice coverage

Frames	US	China	Chi-square	df	Asymp. sig (2-sided)
Political	89	50	.07	1	.79
Economic	113	40	19.14	1	.000
Religious	4	0	2.36	1	.125
Scientific	103	52	1.76	1	.185
Environmental	25	6	4.59	1	.032

Table 9. Results of chi-square tests comparing Thailand and the US in terms of frames employed in their newspapers' GM papaya coverage

Frames	US	Thailand	Chi-square	df	Asymp. sig (2-sided)
Political	54	85	14.00	1	.000
Economic	64	32	20.56	1	.000
Religious, moral	2	1	0.38	1	.536
Scientific	81	49	21.07	1	.000
Environmental	51	40	3.03	1	.082

4.6 Determinants of Frames

Hypothesis 3 submits that the framing of GM events is a function of the degree of press freedom a country's mass media system enjoys and the policy orientation each country has adopted toward biotechnology.

In order to test this hypothesis, chi-square tests were conducted to determine whether the use of each of the four frames (political, economic, science and environmental) differed according to the degree of press freedom assigned to each nation. As Table 10 shows, China and the US only differed in terms of the frequency of their use of the economic frames [$X^2(1) = 12.94, p < .05$] and environmental frames [$X^2(1) = 17.89, p < .05$]. The US newspapers employed 177 economic frames (30%) and 76 environmental frames (13%), more than the Chinese media coverage that showed 40 economic frames (27%) and six environmental frames (4%). Group differences were not found for the political and scientific frames. As Table 11 shows, Thailand and the US differed in terms of the frequency of their use of the political frames [$X^2(1) = 11.86, p < .05$], economic frames [$X^2(1) = 49.08, p < .05$] and scientific frames [$X^2(1) = 24.55, p < .05$]. The US had 177 economic frames (30%) and 184 scientific frames (31%), more than the Thailand coverage that displayed 32 economic frames (20%) and 49 scientific frames (24%). But 41% of Thailand's articles, however, demonstrated political frames, more than that of the US coverage 24% of which exemplify the use of political frames. As Table 12 suggests, China and Thailand differed in terms of the frequency of their use of political frames [$X^2(1) = 6.10, p < .05$], economic frames [$X^2(1) = 6.67, p < .05$], scientific frames [$X^2(1) = 5.27, p < .05$] and environmental frames [$X^2(1) = 22.01, p < .05$]. Thailand had more political frames (85, 41%) and environmental frames (40, 19%) than the Chinese newspapers that published 50 stories that employed the political

frame (34%) and six stories (4%) that were environmental in orientation. The Chinese press had 40 stories demonstrating economic frames (27%) and 52 stories with scientific frames (35%), more than the newspapers of Thailand that printed 32 stories using economic frames (20%) and 49 stories (24%) that are more science-based. Contrary to Hypothesis 3, the US press, considered as “free” and the Chinese press, considered “not free” employed relatively similar frames. The Thai press, however, categorized as “partially free” exhibited different frames.

Table 10. Results of chi-square tests comparing the US and China in terms of frames employed in their newspapers

Frames	US		China		Chi-square	df	Asymp.Sig (2-sided)
Political	143	24%	50	34%	.13	1	.719
Economic	177	30%	40	27%	12.94	1	.000
Scientific	184	31%	52	35%	3.47	1	.062
Environmental	76	13%	6	4%	17.89	1	.000
Total	586	100%	148	100%			

Table 11. Results of chi-square tests comparing the US and Thailand in terms of frames employed in their newspapers

Frames	US		Thailand		Chi-square	df	Asymp.Sig (2-sided)
Political	143	24%	85	41%	11.86	1	.001
Economic	177	30%	32	20%	49.08	1	.000
Scientific	184	31%	49	24%	24.55	1	.000
Environmental	76	13%	40	19%	1.23	1	.268
Total	586	100%	207	100%			

Table 12. Results of chi-square tests comparing Thailand and China in terms of frames employed in their newspapers

Frames	Thailand		China		Chi-square	df	Asymp.Sig (2-sided)
Political	85	41%	50	34%	6.10	1	.013
Economic	32	20%	40	27%	6.67	1	.010
Scientific	49	24%	52	35%	5.27	1	.022
Environmental	40	19%	6	4%	22.01	1	.000
Total	207	100%	148	100%			

Did a country's biotechnology policy have a bearing on frames used? The results of an analysis of variance test conducted to determine if the three countries differed in frames used based on national biotechnology policy indicates less significant influence in terms of number of frames applied. As shown in Table 13, a country's GM stance, whether permissive or promotional, influences framing. These groups differed in terms of the frequency with which they used the political ($F=7.07$, $p<.05$), economic ($F=48.70$, $p<.001$) and science ($F=20.68$, $p<.001$) frames. More political frames (in 143 stories) can be discerned from the US whose biotechnology policy is described as promotional than from China and Thailand whose policies are seen as permissive (135 stories combined). The US also demonstrated more stories that apply the economic frame (177) and the science frame (185) than the two permissive countries combined (72 and 100, respectively). The results therefore show that a country with a promotional policy is likely to produce more politically, economically and science-based frames than countries that have a permissive stance on biotechnology.

Frames, however, are more than the overarching framework that anchors a news discourse. According to Entman (1993), frames also serve to define the social problem to audiences, interpret its causes, assign blame, and propose solutions, among other functions. Therefore, the tone or valence of a story—to the extent that it offers a way of looking at an issue—is an integral framing device. The relationship of degree of press freedom and different national biotechnology policies on the attitude or tone of the stories are thus worth examining.

To determine if story tone differ by degree of press freedom, a chi-square test was conducted. The results, shown in Table 14, indicate a significant difference among the three nations in terms of tone of coverage ($X^2=9.65$, $df=2$, $p<.05$). Across the board, there were

more negative than neutral or positive stories, but the number of negative stories seems to increase with level of press freedom. That is, the more press freedom a country enjoys, the greater the incidence of stories that are negatively disposed toward genetic engineering. This may be due to the availability of competing points of view encouraged by a free press.

Table 15 details the results of another chi-square test conducted to ascertain differences in attitude based on national biotechnology policy. The results show that China and Thailand with permissive national policies toward GM crops and the US with promotional national policies toward GM crops do not differ in terms of the tone ($X^2=4.71$, $df=2$, $p>.05$).

Table 13. Results of analysis of variance tests showing differences between groups based on national biotechnology policy in terms of their use different frames

		Sum of squares	df	Mean square	F	Sig.
Political frames	Between groups	1.708	1	1.708	7.074	.008
	Within groups	115.619	479	.241		
	Total	117.326	480			
Economic frames	Between groups	11.084	1	11.084	48.700	.000
	Within groups	109.016	479	.228		
	Total	120.100	480			
Religious frames	Between groups	.035	1	.035	2.461	.117
	Within groups	6.863	479	.014		
	Total	6.898	480			
Science frames	Between groups	4.807	1	4.807	20.684	.000
	Within groups	111.326	479	.232		
	Total	116.133	480			
Environmental frames	Between groups	.543	1	.543	2.873	.091
	Within groups	90.513	479	.189		
	Total	91.056	480			

Table 14. Chi-square test showing differences in attitude of coverage according to a nation's degree of press freedom

Level of press freedom	Attitude			Total	Pearson chi-square value	df	Asymp.Sig (2-sided)
	negative	neutral	positive				
China, not free	47	19	25	91	9.655	4	.047
Thailand, partly free	64	36	19	119			
US, free	124	96	51	271			
Total	235	151	95	481			

Table 15. Chi-square test showing differences in attitude of coverage according to a nation's biotechnology policy

Biotechnology policy	Attitude			Total	Pearson chi-square value	df	Asymp.Sig (2-sided)
	negative	neutral	positive				
China, Thailand (permissive)	111	55	44	210	4.707	2	.095
US (promotional)	124	96	51	271			
Total	235	151	95	481			

CHAPTER 5

CONCLUSIONS

The tenets of three theories—the hoopla effect, the social amplification of risk framework and framing theory—were used to guide this study’s analysis.

The newspaper coverage of the GM issue in each of the three countries underwent a six-year life span, this study’s specified timeframe. Compared to most science topics, the GM issues in the three countries were covered fairly intensely, producing 157 articles about GM rice in the US papers and 91 in the Chinese press. The intensity of GM papaya coverage was just about the same in the US and Thailand where the issue was the subject of 114 and 119 articles, respectively. The average length of stories (in terms of number of words) concerning GM papaya were just about the same in the US and China (863 and 872 words, respectively). The Thai stories (average=546 words) were significantly shorter than their American counterparts (average=725 words).

Following the axioms of the hoopla effect, triggering events garnered and sustained newspaper interest for a considerable period of time, especially in China and Thailand. In the US, the number of GM rice and GM papaya articles experienced sustained coverage from 2003 to 2006, producing a drastic surge in news stories about GM rice over the last year (2005-2006). Clear triggering effects that bring spikes in newspapers’ coverage of GM events could also be seen in the cases of China and Thailand. In the latter, the number of stories about GM papaya rose dramatically to 60 stories in 2004, and then dropped to 16 articles in 2005. The Chinese coverage of GM rice was relatively flat until 2004 when a

significant rise in coverage accompanied the discovery that Chinese rice for export has been contaminated with a GM variety.

The social amplification of risk framework suggests that social institutions and organizations take on prominent roles in society's handling of scientific issues with risk amplifications. It sees the mass media as a battleground or an arena in which various stakeholders vie for public attention and acceptance of their points of view. In this study, advocacy groups played active roles in shaping newspaper coverage of both GM papaya and GM rice and had a demonstrable negative impact on the newspapers' attitude toward genetic modification.

In general, the tone of the newspaper coverage in the three countries was slightly negative to neutral. The US, by virtue of the journalistic standards of objectivity and balance in reporting, published more stories that were neutral toward genetic modification. Of the three countries, Thailand demonstrated the most negative attitude toward the GM crop in question, not because of a stifled press (categorized by Freedom House as "partly free") but due to the intense lobbying of advocacy groups against GM foods.

The US coverage of GM rice was replete with sources coming from advocacy groups, farmers and politicians. China, on the other hand, cited advocacy groups, politicians and university-based scientists more as sources of information. The Thai coverage of GM papaya overwhelmingly cited advocacy groups. They were followed by farmers and politicians. The US reports on GM papaya relied less heavily on advocacy groups although this category of sources was also the most cited. The US coverage also featured the voices of farmers and politicians. The preponderance of advocacy groups in the top three sources of information across the countries indicate that they dominated the debate, which explains the negative tone

of the coverage overall. The scientific viewpoint was drowned out even by the more strident rhetoric of politicians as scientists who were cited less frequently by the newspapers that endeavored to explain the GM issue to their publics.

This study found an overwhelming use of scientific and economic frames across all nations, except for Thailand where the political frame was the most dominant. In China, there were slightly more scientific than political frames used in the newspaper discourse. The diversity of frames present in the Chinese coverage suggests that the commercialization of media operations has somehow eased up on the government-imposed restrictions on the reporting of science issues.

Did the use of each of the five frames (political, economic, religious or moral, science and environmental) differ according to the degree of press freedom assigned to each nation? The results of chi-square tests indicated that China, the US and Thailand differed in terms of the frequency of their use of the political, economic, science, and environmental frames. Specifically, more political and science frames characterize the coverage of US newspapers, and the frequency with which these two frames were used were significantly different from that of Thailand (characterized as partly free). However, China's predominantly political and science stories—coming from a press system that is not free—were observed more frequently than stories with the same frame in Thailand. The US stories constructed around the economic frame were significantly higher than stories with the same frame in the Chinese and the Thai coverage. There were also significantly more stories in the Chinese newspapers that exhibited this frame compared to that of Thailand. The US also showed more stories employing the environmental frame than China, but Thailand exhibited more environmental frames than China. The results indicate, therefore, that the frequency of frame use according

to press freedom does not follow a linear pattern. Because China outperformed Thailand in its use of the political, economic and science frame, it can be surmised that this relationship might be quadratic or curvilinear.

The findings also suggest a linear relationship between the number of negative stories present in the coverage of GM issues and a nation's level of press freedom. However, the nation's policy toward biotechnology does not guarantee a positive play of the issue in its media system. Although the governments of China and Thailand have advocated for the wider application of biotechnology in the years ahead, the negative depictions of GM issues in their newspapers allude to the fact that the development strategies each nation chooses to implement this innovation may still be in flux.

5.1 Implications of the Findings to Theory and Professional Practice

The results indicate that other contextual factors, such as the strength of science reporting, may influence framing and frame use specifically related to the media's handling of scientific issues. The findings also suggest that the relationship between the level of press freedom and frame use may be curvilinear. This is the same with the relationship between national biotechnology policies and frame use.

The findings demonstrated the vulnerability of newspapers to advocacy groups with the resources to stage events and vociferously counter scientific claims. This was evident in China where many newspapers accepted Greenpeace's argument that foreign-based companies adopt a double standard of exporting organic crops to the EU but shipping GM-laden food to China, a direct appeal to nationalism. In fact, the "double standard" arises from different GM policies in these two places. The Chinese require GM labeling only on some products made from soy, corn, green rape, cotton and tomatoes. The EU, however,

subscribes to a stricter regulatory regime. The lopsided and highly negative coverage of the GM papaya issue in Thailand seems to indicate that sheer credulousness among members of the media—combined with sensationalism and perhaps slow news periods—were the problem. In the US, the persistent demand for balance in reporting contested scientific issues have prompted reporters to search for “experts” with dubious credentials just to be able to present “the other side of the coin.” Determining how much weight to give different sides in a scientific debate requires expertise on the issue at hand. Few journalists have real scientific knowledge, and even beat reporters who know about certain issues know little about others. They can all too easily fall for scientific-sound claims that they cannot evaluate on their own.

The results show the range of forces that influence media framing of the GM debate. In this struggle, the political powers are by no means the only players. How the media frame issues related to risks, and how effective various information sources are in gaining access to the media to present their views, are important in gaining public acceptance.

5.2 Limitations of the Study and Suggestions for Future Study

While the study may have interesting implications, there are a number of important limitations. First, the study analyzed only English-language newspapers in three countries, two of which are generally non-English speaking. Examining the coverage of GM rice and GM papaya in the native languages of China and Thailand may indeed show different frames, perhaps with a more local flavor, than those of English-language newspapers that usually target a nation’s elite.

Second, an examination of patterns coverage reveals that explosions in coverage, particularly regarding GM rice in the US, have occurred relatively recently. This suggests that a longer timeframe of analysis is in order.

Third, there are other factors that may have an influence on media frames. Among others, the cadre of science reporters and the strength of science reporting in a given country must have something to do with the richness and variety of frames newspapers employ. Moreover, the extent to which a country is also dependent on agriculture as a percent of GNP might have a bearing on how strongly reporters can take on a science issue and adhere to specific frames.

Fourth, this study examined media frames exclusively as a dependent variable. The news media, by putting events in different frames and binding the news reporting with them, can provide the basis for how the public understands this ongoing debate. Future studies should therefore explore media frames as an independent variable that might have an impact on audiences' attitudes, opinions, or individual frames about crop genetic modification.

APPENDIX A

CONTENT ANALYSIS CODING SHEET

Variable	Instructions and values	Code
ID	Number each individual story consecutively	
Coder	Coder's first name	
Country	Each country corresponds to a specific biotech innovation: 1=China (genetically modified rice) 1A= the US (genetically modified rice) 2= Thailand (genetically modified papaya) 2B= the US (genetically modified papaya)	
Paper	Newspaper name, enter as a string variable	
Type	Categorize story as 1= straight news 2= feature article 3= editorial or editorial column 4= letter to the editor/newspaper	
Author	Determine origin of the story 1= story from an international wire service 2= story from a local wire service 3= story written by newspaper reporter 4= reader's response or letters 5= other	
Date	Date of story publication. Enter as month, day, year (i.e., 06-04-06)	
Universi	Universities and university-based research institutions' scientists 0= absent in the story 1= present in the story	
Govt	Scientists from government agencies 0= absent in the story 1= present in the story	
Othsci	Other scientists 0= absent in the story 1= present in the story	

Journs	Scientific journals and journal editors 0= absent in the story 1= present in the story	
Industry	Industries , industry associates, wholesalers 0= absent in the story 1= present in the story	
Citizens	Ordinary citizens and consumers, but not farmers 0= absent in the story 1= present in the story	
Advocate	Advocacy groups 0= absent in the story 1= present in the story	
Intl	International not-for-profit groups, but not Greenpeace and the like. 0= absent in the story 1= present in the story	
Politics	Politicians and government employees, but not government scientists. 0= absent in the story 1= present in the story	
Farmers	Farmers and farmers associations. 0= absent in the story 1= present in the story	
Others	Other sources, including religious leaders 0= absent in the story 1= present in the story	
Source	Total number of sources cited in the story	
Length	Length of story in number of words	
Political	Political frame 0= absent in the story 1= present in the story	
Economic	Economic frame 0= absent in the story 1= present in the story	
Moral	Religious, moral, ethical frame 0= absent in the story 1= present in the story	
Scientific	Scientific frame 0= absent in the story 1= present in the story	
Environmental	Environmental frame 0= absent in the story 1= present in the story	

Othframe	Other frame 0= absent in the story 1= present in the story	
Positive	Does it make any positive statement about genetic engineering? 0=No 1=Yes	
Negative	Does it make any negative statement about genetic engineering? 0=No 1=Yes	
Tone	General orientation of the story with respect to genetic engineering 1= negative 2= neutral 3= positive	
Free	Freedom House press freedom ranking 1= not free 2= partly free 3= free	
Biotech	National biotechnology policy 1= promotional 2= permissive 3= precautionary 4= preventive	

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ACKNOWLEDGEMENT

This thesis would not have been possible without the support of many people. Many thanks to my Major Professor, Lulu Rodriguez, who read my numerous revisions, gave me valuable advice and helped me make great changes to it. Also thanks to my committee members, Professor Abbott and Professor Wolt who offered great guidance and support. And thanks Huang Yong for coding work and helping me check the format. Finally, I'd like to thank to my parents and boyfriend Jin Wu who endured this long process with me, always offering limitless support and love.